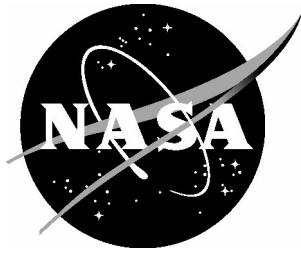


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Vibro-Acoustic Response of Buildings Due to Sonic Boom Exposure: June 2006 Field Test

*Jacob Klos and Ralph D. Buehrle
Langley Research Center, Hampton, Virginia*

September 2007

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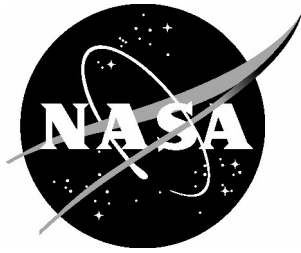
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National Aeronautics and
Space Administration

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PREFACE

During the month of June 2006, a series of structural response measurements were made on a house on Edwards Air Force Base (EAFB) property that was excited by sonic booms of various amplitudes. Many NASA personnel other than the authors of this report from both Langley Research Center and Dryden Flight Research Center participated in the planning, coordination, execution, and data reduction for the experiment documented in this report. The authors of this report would like to acknowledge the support of all those people involved in this test.

The purpose of this report is to document the measurements that were made, the structure on which they were made, the conditions under which they were made, the sensors and other hardware that were used, and the data that were collected. To that end, Chapter 2 documents the house, its location, and the physical layout of the house and surrounding area. Chapter 3 documents the sensors and other hardware that were placed in the house during the experiment. In addition, day-to-day variations of hardware configurations and transducer calibrations are documented in Chapter 3. Chapter 4 documents the boom generation process, flight conditions, and ambient conditions of the outside environment during the test days. Chapter 5 includes information about sub-experiments that were performed to characterizing the vibro-acoustic response of the structure, the acoustic environment inside the house, and the acoustic environment outside the house. Chapter 6 documents the data format and presents examples of reduced data that were collected during the test days.

CHAPTER 1: INTRODUCTION AND TEST OVERVIEW

Civilian supersonic flight over land is restricted due to the environmental impact of sonic booms on populations over which the aircraft would fly. The sound produced on the ground by sonic booms, characterized by the classic N wave with a high overpressure and fast rise time, is found to be intrusive enough to a populace to warrant these blanket restrictions. However, there is currently a desire among airplane manufacturers to design, build, and market supersonic business jets enabling supersonic flight over land using technology to mitigate boom intrusiveness. This goal has been further motivated by the demonstration of sonic boom shaping by DARPA, NASA, and industrial partners during a recent experiment.¹ In that experiment, it was shown that the peak overpressure of a sonic boom could be reduced in a predictable way by shaping the airframe. By shaping future aircraft to modify the shock structure, several airframe builders are pursuing novel business jet designs that should result in significantly lower boom overpressures and slower rise times than those produced by current supersonic aircraft. Thus, there is hope that, due to the lower overpressures observed on the ground, these designs could be capable of flying supersonically over populated land without creating objectionable noise.

However, supersonic flight over land will only be possible after modification of restrictions that are currently in place. Such modifications will require substantial justification that boom signatures generated on the ground by low boom aircraft are not objectionable to citizens. Thus, to evaluate the effects of low amplitude sonic booms, and ultimately affect decisions regarding supersonic flight restrictions, knowledge and tools need to be developed to enable study of the noise generated by low overpressure booms. One aspect of this effort needs to be focused on commonly populated environments, such as inside residential buildings. For the purposes of development and validation of indoor structural acoustic modeling tools, a series of tests was conducted by NASA personnel on a house exposed to several sonic booms of different peak overpressures. The tests conducted during this experiment included indoor and outdoor human subjective response studies, as well as building structural and acoustic response measurements. The focus of this report is to document the building vibro-acoustic response measurements.

During the month of June 2006, a large set of structural acoustic response measurements was made in a house on Edwards Air Force Base (AFB) property. The ranch style house used in this test is shown in Figure 1.1. More detail about the house and its physical layout is documented in Chapter 2. Requirements for the subjective response studies led to the house being exposed to a large number of low overpressure sonic booms. Over the course of six days of testing, the structural acoustic response of the house was measured for 112 sonic booms that ranged in overpressure from approximately $0.05 \text{ lb}_f/\text{ft}^2$ to $1.8 \text{ lb}_f/\text{ft}^2$ as measured by a ground microphone placed outside the house. This range of

¹ K.J. Plotkin, J.A. Page, D.H. Graham, J.W. Pawlowski, D.B. Schein, P.G. Coen, D.A. McCurdy, E.A. Haering, J.E. Murray, L.J. Ehernberger, D.J. Maglieri, P.J. Bobbitt, A. Pilon, J. Salamone, "Ground Measurements of a Shaped Sonic Boom", Proceedings of the 10th AIAA/CEAS Aeroacoustics Conference, Paper number AIAA 2004-2923, 2004.

overpressures spanned those that are believed to be obtainable from supersonic business jets incorporating low boom designs (0.1 to $0.3 \text{ lb}_f/\text{ft}^2$) in addition to typical those generated by conventional aircraft (typically greater than $1 \text{ lb}_f/\text{ft}^2$). All 112 sonic booms studied were generated using F/A 18 aircraft maintained, operated and flown by NASA Dryden personnel. Typically, an F/A 18 aircraft would not be capable of generating a sonic boom with overpressures in the lower portion of the range studied. However, a unique dive maneuver (Figure 1.2) was used to generate sonic booms that resulted in the low overpressure observed at the house. More detail on the boom generation process is given in Chapter 4. Of the 112 sonic booms measured during this experiment, 98 were low overpressure booms generated by the dive maneuver and ranged from $0.05 \text{ lb}_f/\text{ft}^2$ to $0.80 \text{ lb}_f/\text{ft}^2$. The other 14 booms were generated by straight and level flight of the F/A 18 over the test house and were intended to be representative of booms generated by current aircraft. The overpressure range observed at the house from these normal amplitude booms was from $0.84 \text{ lb}_f/\text{ft}^2$ to $1.8 \text{ lb}_f/\text{ft}^2$.

Roughly 288 transducers, a mix of accelerometers and microphones, were installed both inside and outside the house. All the transducers were simultaneously sampled and recorded at sample rate of either 25,600 or 51,200 Hz. The hardware used to make these measurements and the available data are detailed in Chapters 3, 4, 5 and 6. Two bedrooms in the house were heavily instrumented with accelerometers and microphones and the indoor subjective area was lightly instrumented with transducers (Figure 1.3). Accelerometers were attached to the walls, windows, and ceilings in the three rooms of the house (Figure 1.3) to measure the vibration response of these structures to the boom excitation. The microphones in each room were placed in random locations to sample the resulting interior noise. In addition, several microphones were placed outside, surrounding the house, to characterize the excitation field and measure the diffraction of the boom around the house. More detail is included in Chapter 3 concerning the transducer types used, layout of the transducers, and changes that were made to the hardware as the experiment progressed. With all the instrumentation in place inside and outside the house, several simple tests were conducted to characterize the response of the house's acoustic spaces and structural elements of the house. These tests are documented in Chapter 5. These simple tests included shaker excitation of the walls and windows, impact hammer measurements of the walls and windows, reverberation measurements inside the three instrumented rooms using a Brüel and Kjær sound level meter, and impulsive brown paper bag pops inside all of the rooms and outside the house at various locations.

The focus of this report is documenting the structural acoustic measurements that were performed on the house during this experiment. However, there was a parallel research effort that was designed to assess the subjective response of people who were exposed to the booms observed at the house. Human subjects were placed in two locations and asked to evaluate the sonic booms heard at the house relative to a reference sound that was played through speakers. Subjects were seated both inside the house in the main living area and outside the house in the back yard (Figure 1.3). In each of these subjective seating areas, ten people sat and listened to the booms generated from F/A 18 aircraft and reference sounds played through speakers placed behind the subject's head

(Figures 1.4 and 1.5). The main reason that this subjective test is mentioned in this report is to make the reader aware of possible influences that the presence of the human subjects may have had on the data quality of the indoor and outdoor structural acoustic measurements. In some of the recordings, background sounds that are a result of the presence of the human subjects, such as coughing and shuffling of feet, can be heard. In addition, the sounds that were played through the speakers are also audible to some extent in the structural acoustic measurements. These noises do not appear to contaminate significantly any of the measurements made in the two heavily instrumented structural acoustic measurement rooms (Figure 1.3). However, the possibility of data contamination should be understood by the reader before using any of the data from these tests. Several microphones were placed near the indoor and outdoor human subjects as documented in Chapter 3. Thus, these microphones can be used to identify when ambient noise levels are high as a result of the presence of the human subjective testing.



Figure 1.1: Photograph of the front of the house.



Figure 1.2: Photograph of the dive maneuver of the F/A 18 aircraft that was used to generate the low amplitude sonic booms.

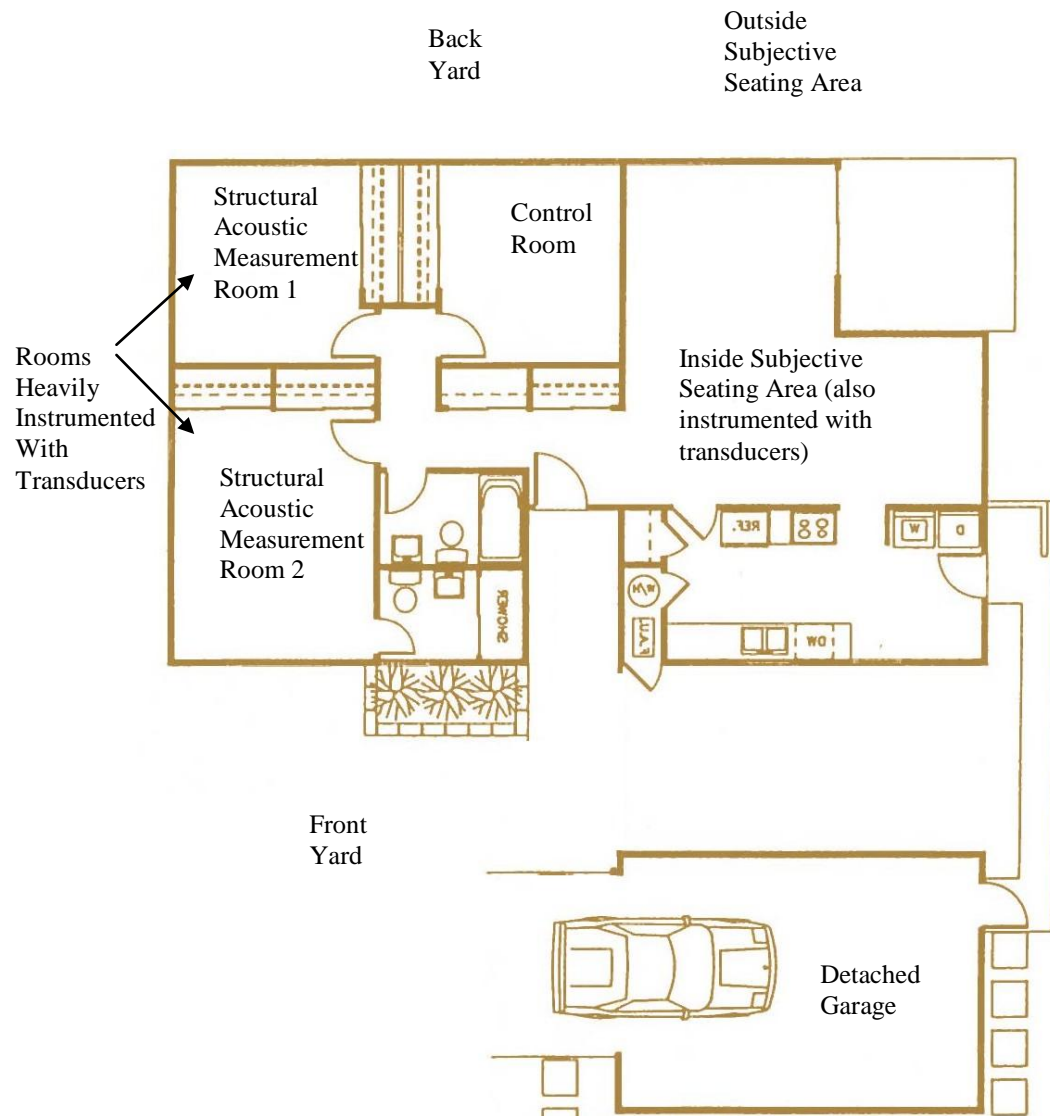


Figure 1.3: Schematic of the house illustrating the subjective areas and the rooms instrumented for structural acoustical measurements.



Figure 1.4: Photograph of the indoor group of human subjects evaluating sounds.



Figure 1.5: Photograph of the outdoor group of human subjects evaluating sounds.

CHAPTER 2: HOUSE DESCRIPTION

The 1,260-square foot house used for this test was a three-bedroom ranch style house, with a detached garage, located in the base housing area of Edwards Air Force Base. Basic construction consisted of a concrete slab floor, 2 x 4 wood framing, and a stucco exterior. The physical address of the house, scheduled for demolition in early 2007 due to age, was 7334 Andrews Avenue, Edwards, CA. This chapter provides a brief physical description of the inside and outside of the house and the surrounding area. Chapter 3 provides a description of the transducers, data acquisition equipment, and any other hardware installed in the house during this test, including mounting locations and daily placement variations.

Section 2.1: Indoor house description

The floor plan of the house at 7334 Andrews is shown in Figure 2.1 and Appendix A. There are three bedrooms, one main living space, a kitchen, two bathrooms, and a detached garage. Note that the orientation of the floor plan is illustrated relative to the approximate cardinal directions in the figures in this chapter. These cardinal directions are used to identify the orientation of the walls of each room in the architectural drawings in the attached appendices. One bedroom was used for a control room (Figure 2.1). This control room contained all the equipment needed to conduct the test. Three other rooms in the house, the main living area and the two bedrooms located along the north side of the house, were instrumented with accelerometers and microphones during this test. These three instrumented rooms are shown in Figure 2.1. 239 transducers were placed into the two bedrooms and are documented in the next chapter. For illustrative and reference purposes, photographs of the back and front bedrooms are presented in Figures 2.2 and 2.3 respectively. Photographs of the main living area are shown in Figure 2.4.

The dimensions of the two bedrooms, the locations of features in the bedrooms (e.g. doors, windows, and lighting fixtures), and approximate wall stud locations are documented in architectural drawings provided in Appendix A. It should be noted that these architectural drawings are estimates based on measurements made by the researchers involved in this experiment. Unfortunately, no drawings of the actual house construction could be obtained from the Air Force. The vertical wall stud locations are estimates determined from stud finder measurements. The horizontal wall stud locations are estimates based on the physical features of the room, such as the door and window locations. The room sizes were measured with both a tape measure and a laser distance-measuring device, and the two measurements were typically within acceptable agreement. Detailed architectural drawings of the indoor subjective seating area are not included in this document because the structural acoustic response in this area of the house is not the primary focus of this report. A brief description follows of the notable features in the two bedrooms and possible sources of interior noise in these spaces.

The ceiling in the back bedroom was vaulted at a 14-degree angle (Figure 2.2), and the interior ceiling sheet rock was attached directly to the rafters of the roof. There were no lighting fixtures attached to the ceiling in this bedroom. In the back bedroom there was a

window in the east wall of the room (Figure 2.2a). The dimensions of the window opening were 4 feet high by 6 feet long. The window consists of two equally sized glazings, a metal frame holding each glazing, and a metal track attached to the house (Figure 2.5). Only the right side of the window was operable (Figure 2.2a) and opened by sliding horizontally in the metal track (Figure 2.5). The left side of the window did not open because it was fixed in the track. It should be noted that both glazings exhibited significant rattle, under even modest excitation applied to either the walls or windows, due to very loose fit of the metal frame in the metal track. Small pieces of paper towel were stuffed in between the window frame and the metal track to reduce the rattle of the window. On the north wall of the back bedroom were two irregularly shaped windows (Figure 2.2d). The two window glazings were held in a wood frame that was attached to the framing of the house (Figure 2.6). There were no metal pieces in contact with the windowpanes of these windows. The fit of these panes in the wood frame was significantly tighter than the fit of the metal window in the east wall (Figure 2.2a). However, the panes did exhibit some rattle. Framed into the south wall of the back bedroom (Figure 2.2b) was a closet. The closet doors and hanger rods were removed prior to all the tests documented in this report. The wood shelves were left in place and are shown on the architectural drawings provided in Appendix A. The shelves were nailed tightly to the walls and did not exhibit rattle. The entry door to the room on the south wall was closed while measurements were made. Above the entry door, there was a large vent for the heating, ventilation, and air conditioning (HVAC) system (Figure 2.7). The HVAC system was always turned off during testing. There was one light fixture on the west wall of the back bedroom (Figure 2.7). While it was slightly loose, it did not appear to be loose enough to be a significant source of rattle. The light shade was left on during testing.

Similar to the back bedroom, the ceiling in the front bedroom was vaulted (Figure 2.3), and the interior ceiling sheet rock was attached directly to the roof's rafters. In the front bedroom, a large support beam ran along the ceiling from the north to the south wall (Figure 2.3a, b, and d). In addition, there was a ceiling fan mounted to the ceiling (Figure 2.3c). The fan did not appear to be a significant source of either rattle or other noise. There were windows in the west and north walls of this room (Figure 2.3c and d). These windows were of similar design and rattle characteristics to those of the back bedroom discussed in the preceding paragraph. A double closet was located along the west wall of the front bedroom (Figure 2.3a). The closet doors and hanger rods were removed prior to the tests documented in this report. The wood shelves were left in place and are shown on the architectural drawings provided in Appendix A. They were nailed tightly to the walls and did not exhibit rattle. Two doors and two light fixtures were located on the south wall (Figure 2.8). While the two light fixtures on the south wall were slightly loose, they did not appear to be loose enough to be a significant source of rattle. The light shades were removed prior to testing. The locations of these light fixtures are indicated in Appendix A. The entry door to the room and the door to the bathroom, the doors on the left and right side of Figure 2.8 respectively, were closed during measurements. The fit of these doors was tight and did not appear to be a source of either rattle or creaking. On two occasions, the toilet in one of the bathrooms was running intermittently during measurements. Noise caused by the running toilet should be

identifiable in the time history of accelerometers mounted to the walls in the front bedroom. Above the entry door was a large HVAC vent (Figure 2.8). The HVAC system was always turned off during testing.

Without some absorption, the rooms would have been very reverberant, and would not adequately represent the interior of a typical dwelling. Queen size foam mattress pads were placed in the front and back bedrooms to increase the acoustic absorption in these rooms (Figure 2.9). Six mattress pads were placed into the front bedroom; two were placed on the floor near the middle of the room and four lined the closet wall (Figure 2.9a). Five mattress pads were placed in the back bedroom; two were placed on the floor in the middle of the room, one was folded in half and placed on the closet floor, and two lined the closet wall (Figure 2.9b). The foam mattress pads were nominally 1 inch thick, roughly 72 by 60 inches in size, and were made from open cell foam. Reverberation time measurements were made to characterize the rooms in the presence of the foam pads. These measurements are documented in Chapter 5.

Section 2.2: Outdoor house description

The front, back, and side yards of the house used in this experiment are shown in Figures 2.10 through 2.12, respectively. Features of interest in the back yard of the house are presented in Figures 2.13 through 2.15. Aerial photographs of the house and surrounding area are shown in Figures 2.16 through 2.18. Architectural drawings and higher resolution photographs of the house and garage exterior are provided in Appendix B. The architectural drawings presented in Appendix B were estimated from measurements made by hand using a tape measure. In addition, a Global Positioning System (GPS) survey of the house and garage was performed by NASA Dryden and is provided in Appendix C. These survey locations should be helpful in orienting the house relative to the aircraft position data documented in Chapters 4. Also, several microphones were placed outside the house to measure the exterior sound field exciting the structure and the diffraction around the house. However, for brevity, a discussion of the nominal exterior transducer layout is not given in this chapter, but is documented in Chapter 3. A discussion of some of the exterior features of the house and surrounding area follows.

An air conditioner unit, or “swamp cooler”, was mounted to the roof of the house (Figure 2.11) and was located approximately over the back bedroom closet. The size of the swamp cooler and the location of the swamp cooler relative to the roof layout are illustrated in Appendix B. From the dimensions presented in Appendices A and B, the location of the swamp cooler relative to the floor plan of the back bedroom should be evident. It should also be noted that five microphones were placed on the roof; one of the microphones was close to this swamp cooler. More discussion of the locations of these roof microphones and the proximity to the swamp cooler is given in Chapter 3.

A brick fence of cinder block construction, identifiable in the photographs shown in Figures 2.11 through 2.16, surrounded the backyard and varied in height off the ground (Figure 2.13). The locations of the corners of the fence are included in the GPS survey data presented in Appendix C. Diffraction around this fence may be important when

considering the microphone measurements made in the backyard. Also, the top of this brick fence was fairly level. Thus, the grade of the back yard relative to the house may be estimated from the photos of this fence knowing that the blocks were roughly 12 inches long by 6 inches high. Detailed photos of the fence surrounding the house are available on request. A small privacy wall was originally part of the patio in the back yard (Figure 2.14a). This privacy wall was knocked down prior to this test (Figure 2.14b) to avoid possible interference with interior and exterior microphone measurements.

Aerial photography of the house and surrounding area is shown in Figure 2.17. Directly to the west of the house is a park where Andrews Avenue separated the park from the house. Noises from the park, such as children playing, pedestrian noises, and traffic noise from Andrews Avenue were possibly recorded on the exterior microphones.

One tree was in the back yard of the test house at 7334 Andrews Avenue and three trees were in the back yard of the neighboring house (Figures 2.15 and 2.16). The presence of these trees may have had some impact on the measurements recorded by the microphones placed in the back yard (microphone locations are detailed in Chapter 3). The most significant affect of the trees on these measurements appeared to be increased noise due to leaf rustling, which can clearly be heard in recordings made on windy days.

The section of base housing where the test house was located was undergoing a complete renovation. All the housing present in this area was to be demolished in stages starting in 2005 and ending in 2008. The housing identified in Figure 2.20 was undergoing demolition during this test. This area was only located a few blocks from the house. Consequently, noises associated with demolition, including moving of heavy machinery and crushing of concrete slabs, could be heard at the house and were recorded by the microphones. Typically, the noises associated with heavy machinery included exhaust noise and warning beeps as the machines were moved around the deconstruction site. In addition to the noises associated with demolition, during some of the later measurement days, construction of new housing started. Sounds associated with this construction may be evident in the recordings.

Section 2.3: Some relevant dimensions

In addition to the dimensions presented in the architectural drawings of the house interior and exterior provided in Appendices A and B, estimates of the dimensions of other relevant features are listed in Table 2.1.

Table 2.1: Dimensions of Various Items

Description	Dimension
Window Glass Thickness	0.115 inches
Stucco Thickness	1.0 inches
Stud Thickness	3.5 inches
Stud Width	1.5 inches
Sheetrock Thickness	0.375 inches

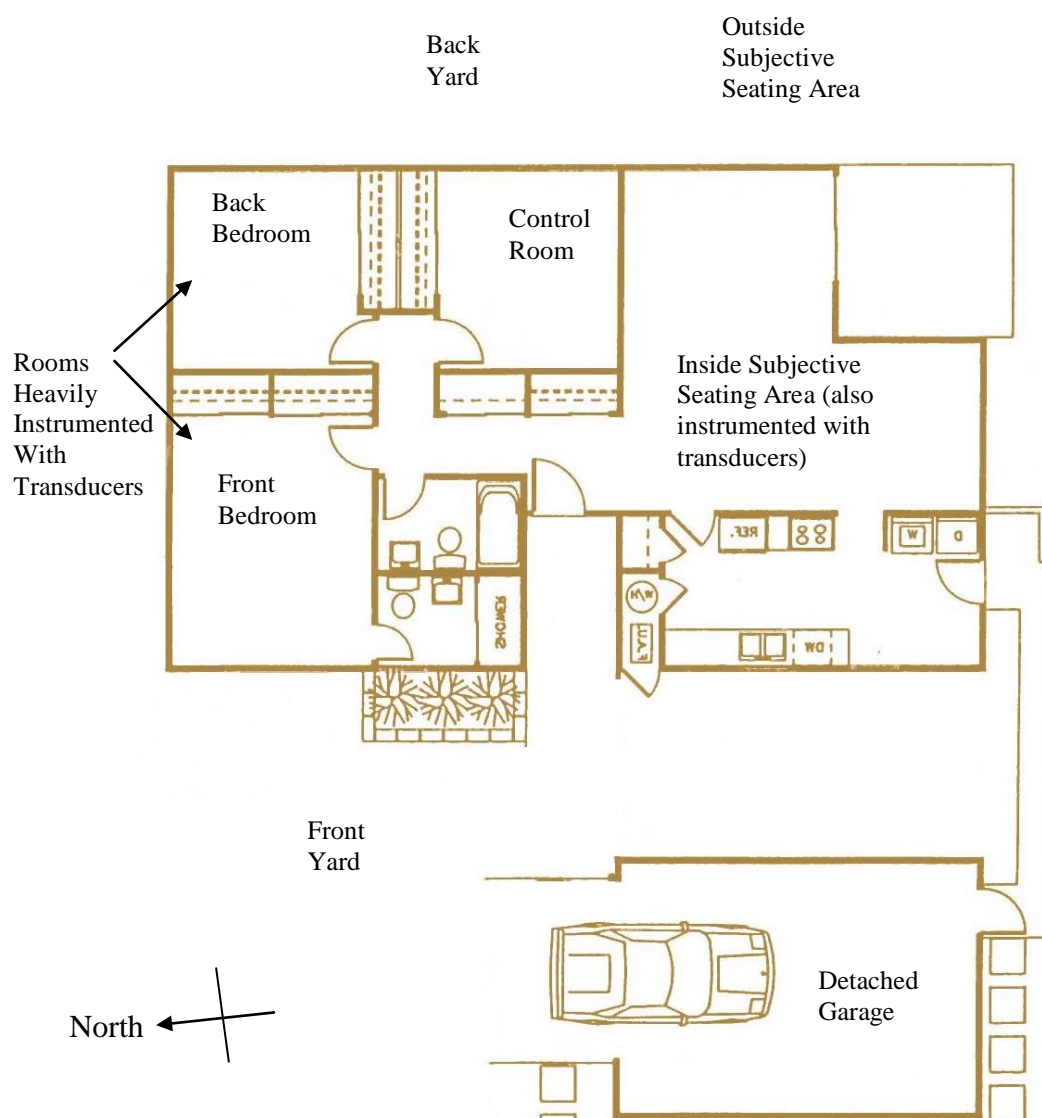


Figure 2.1: Floor plan of the house illustrating the subjective areas and the two bedrooms instrumented for structural acoustical measurements.

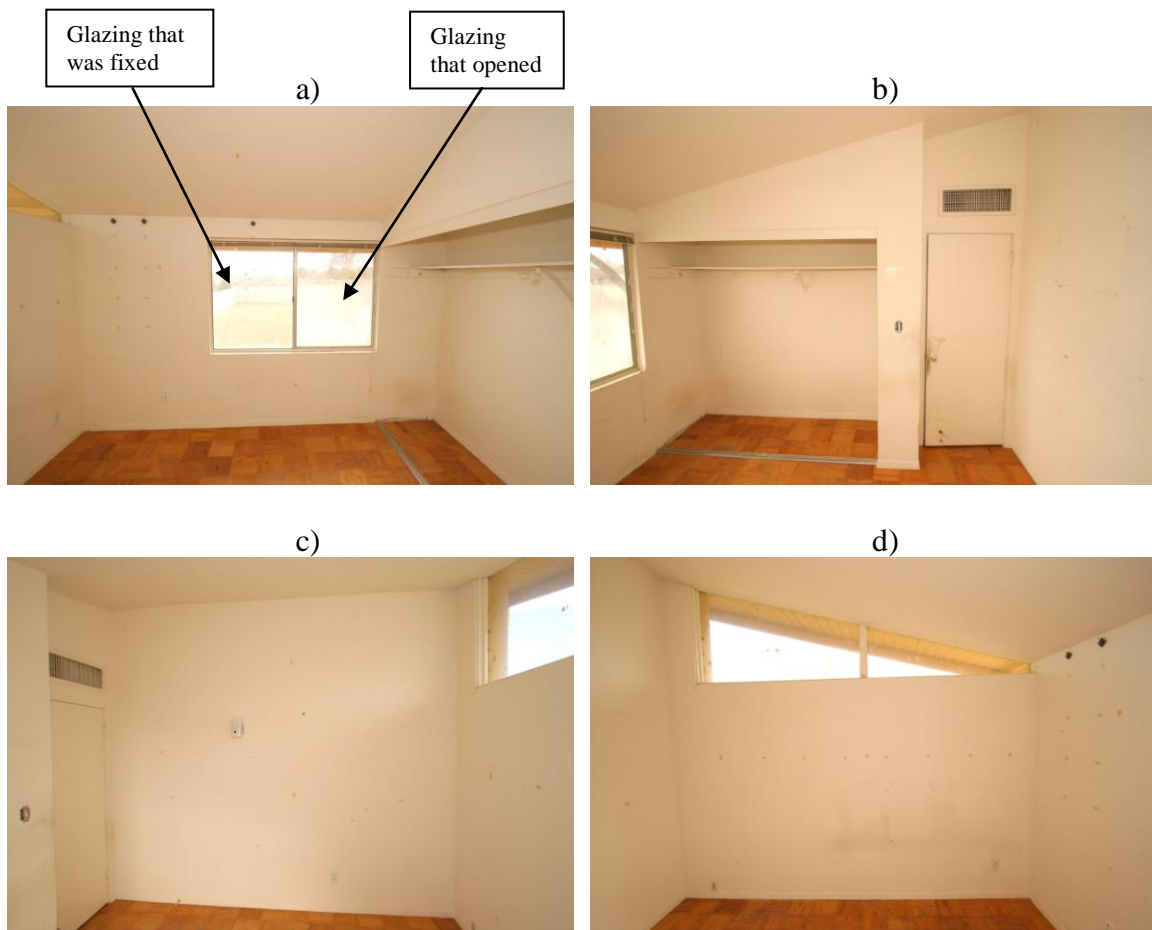


Figure 2.2: Photographs of the walls of the back bedroom; a) east wall, b) south wall, c) west wall, and d) north wall. See Appendix A for larger photographs and detailed drawings of this room.

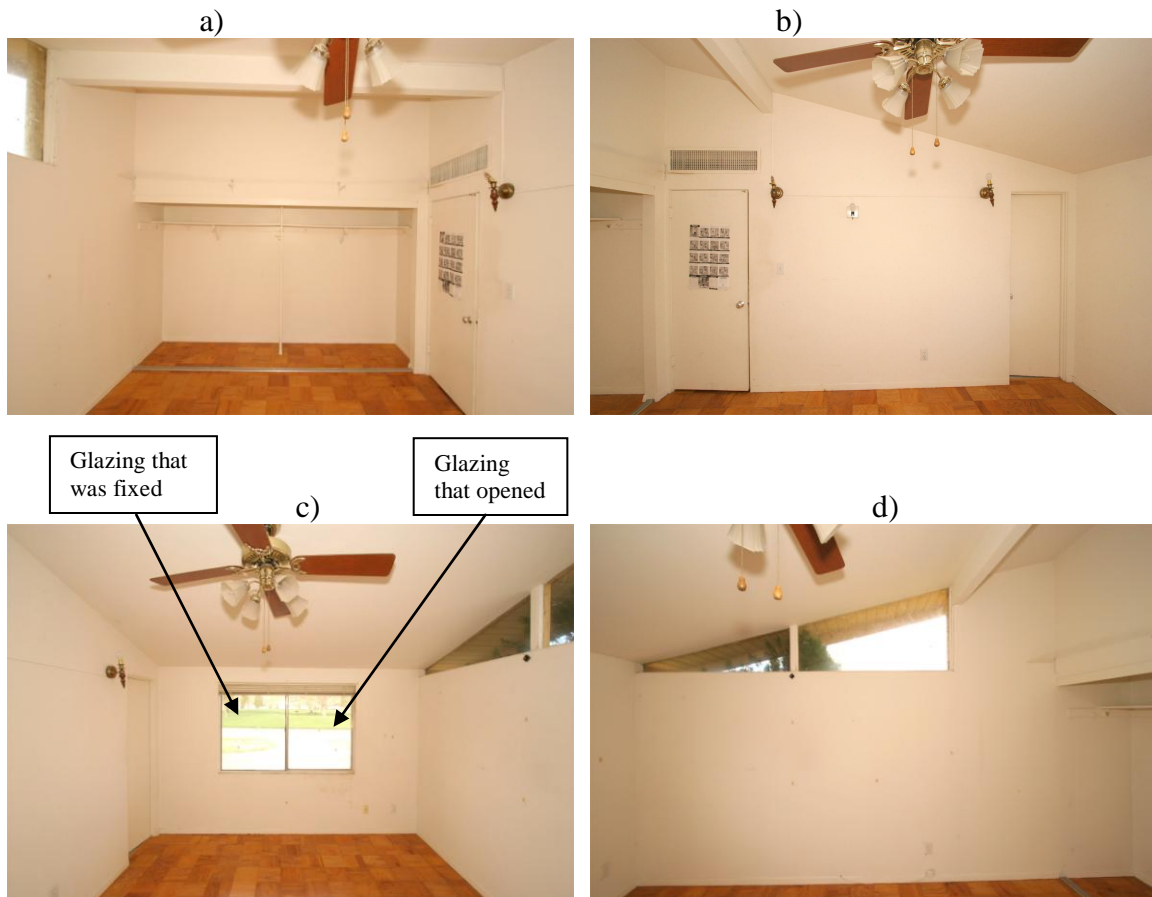


Figure 2.3: Photographs of the walls of the front bedroom; a) east wall, b) south wall, c) west wall, and d) north wall. See Appendix A for larger photographs and detailed drawings of this room.



Figure 2.4: Photographs of the walls of the inside subjective room illustrating exterior walls and subjective seating locations.

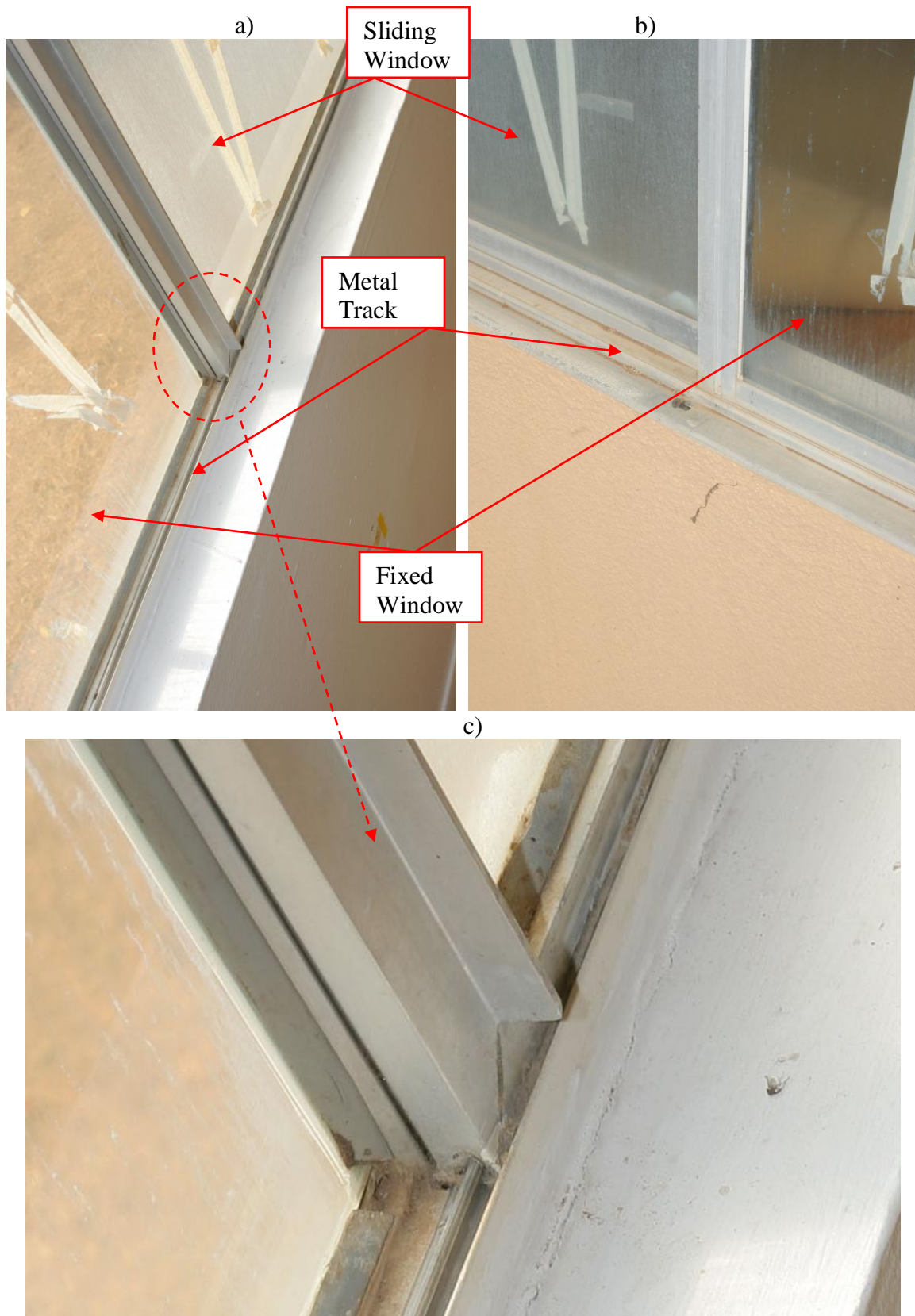


Figure 2.5: The 4-foot by 6-foot window a) looking at the window from inside the house, b) looking at the window from outside the house, c) detail of the track and frames.

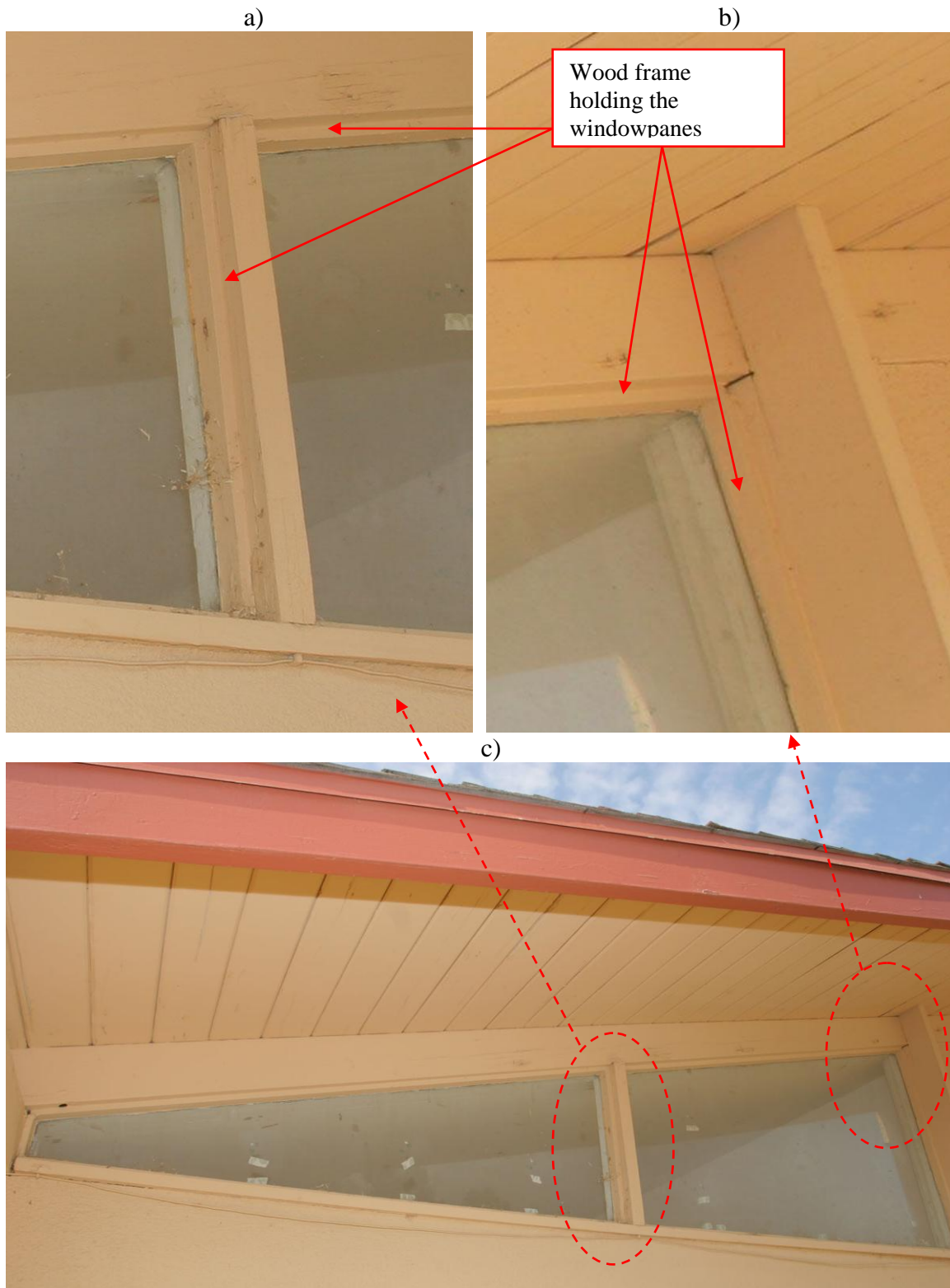


Figure 2.6: a) Window detail of the windows in the north wall of both structural acoustic measurement rooms, b) detail of the frame holding the glazings, c) looking at the windows from outside the house.

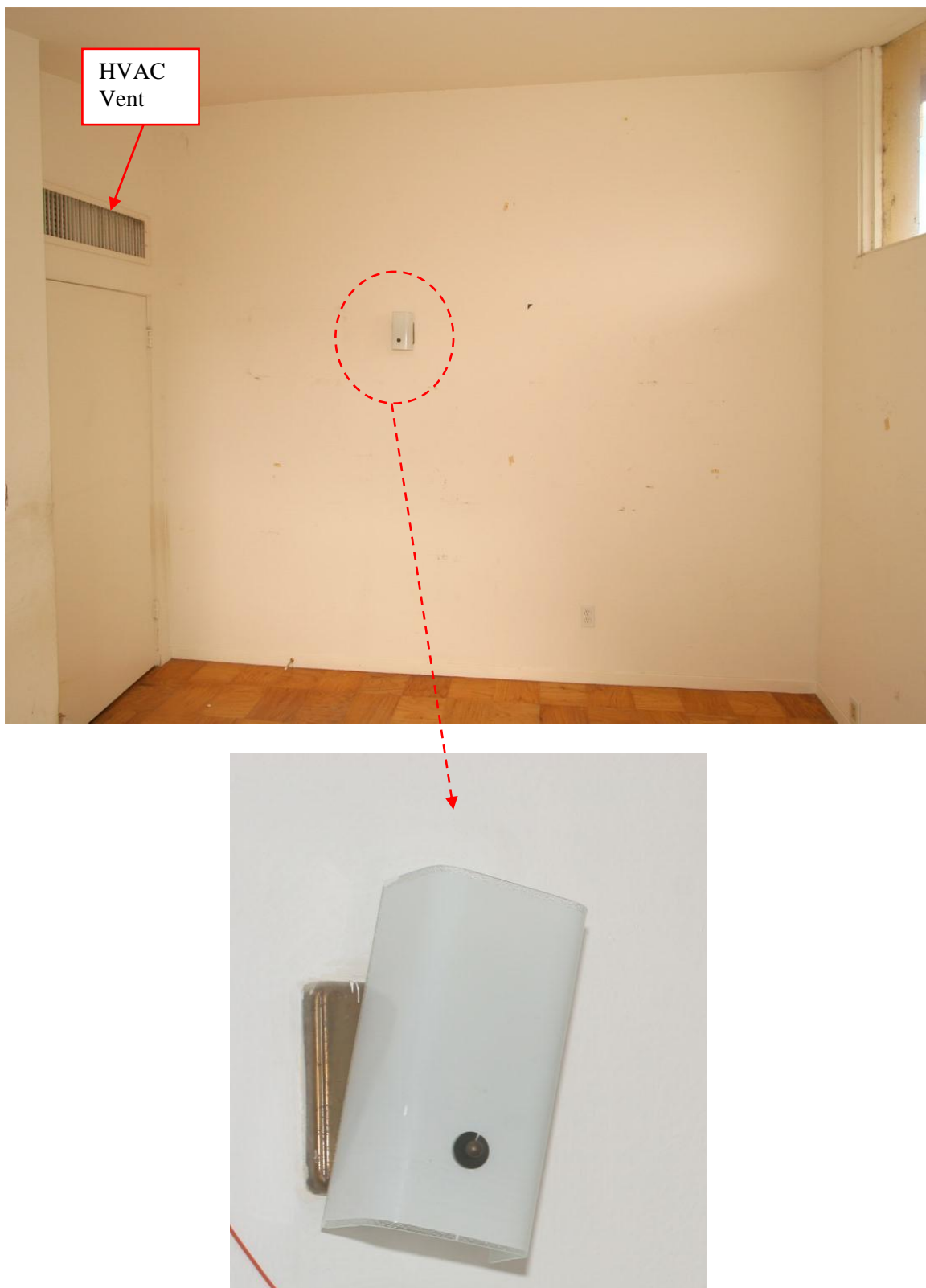


Figure 2.7: Picture of the lighting fixture on the west wall of the back bedroom.

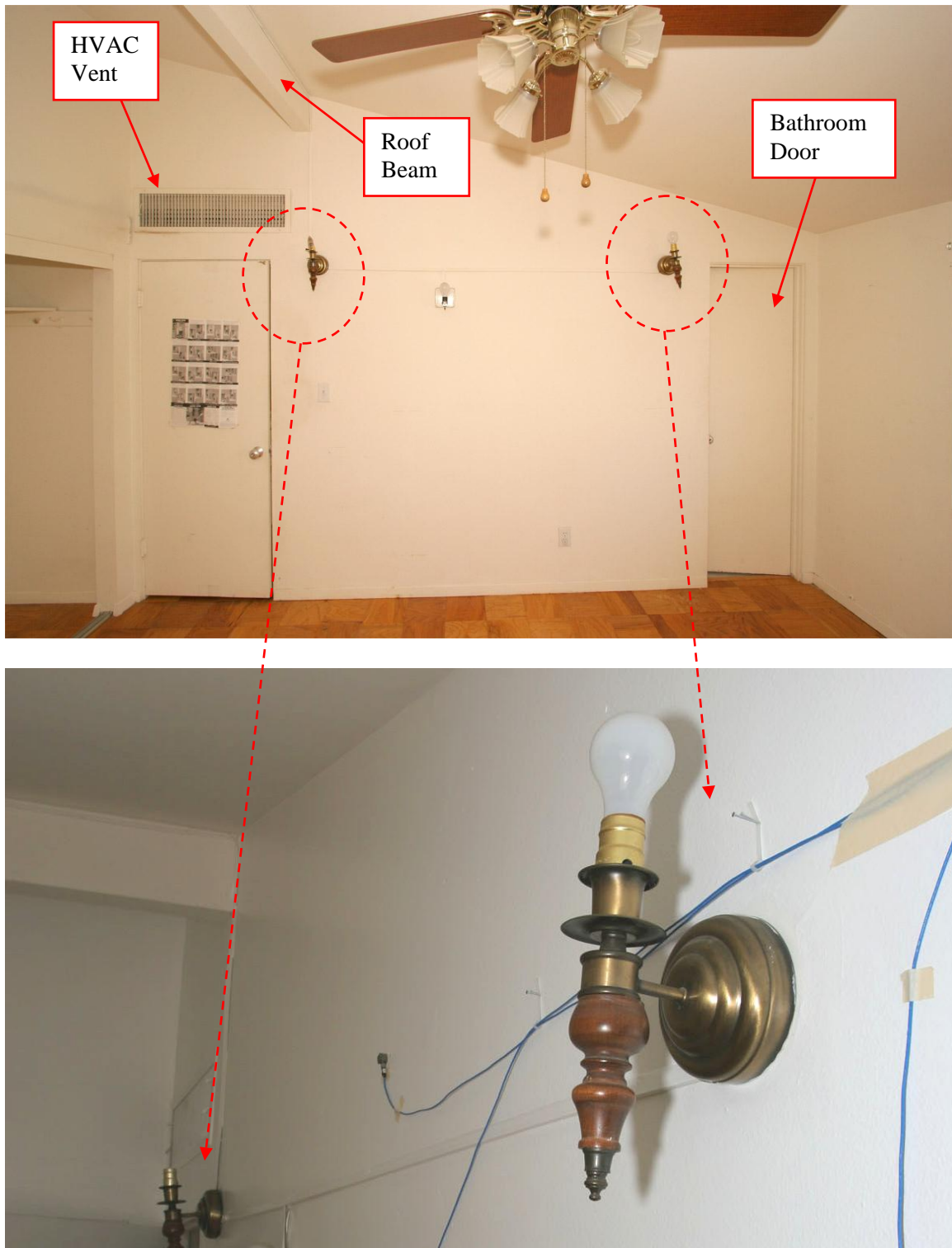


Figure 2.8: Picture of the lighting fixtures on the south wall of the back bedroom.



Figure 2.9: Nominal configuration of the foam mattress pads used to increase the acoustic absorption of a) the front bedroom (six pads total) and b) the back bedroom (five pads total).



Figure 2.10: Front view of the house at 7334 Andrews Avenue.



Figure 2.11: Back view of the house at 7334 Andrews Avenue.



Figure 2.12: Side view of the house at 7334 Andrews Avenue illustrating the north wall of the heavily instrumented structural response rooms.



Figure 2.13: Photographs of the back yard illustrating the fence surrounding the house.

a)



Privacy wall

b)



Privacy wall

Figure 2.14: The privacy wall in the back yard shown in a) was knocked down for this test as shown in b).

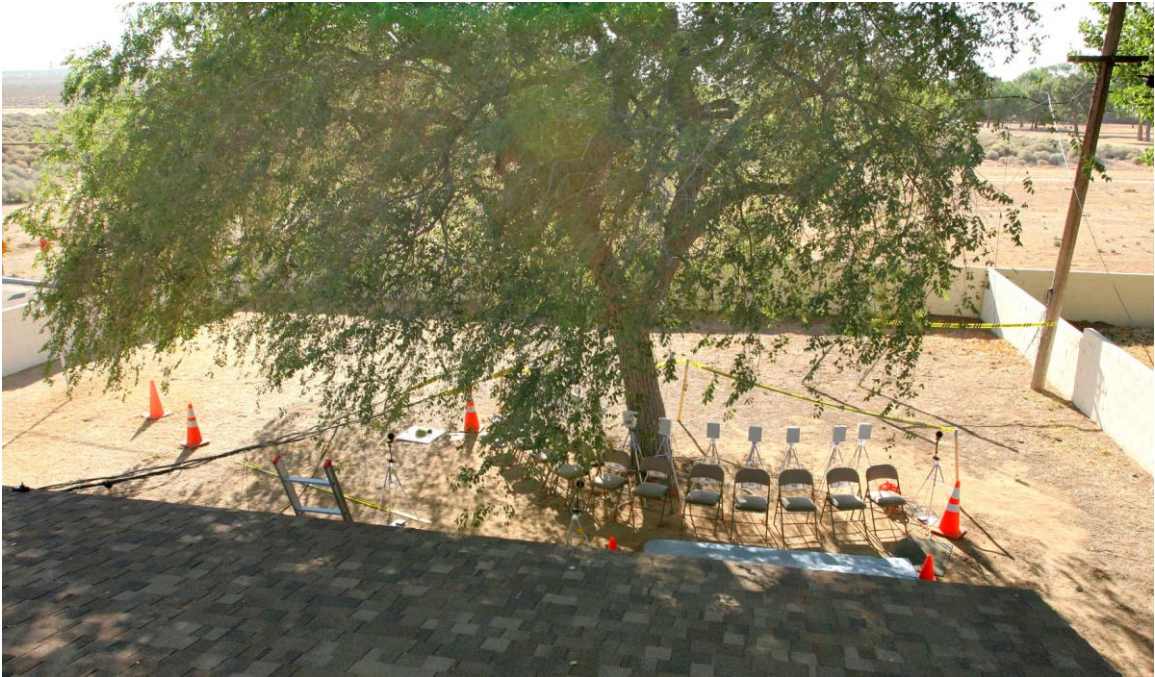


Figure 2.15: Photograph of the tree in the back yard and of the subjective seating area under the tree.



Figure 2.16: Aerial photograph of 7334 Andrews Avenue, Edwards, CA.



Figure 2.17: Aerial photograph of 7334 Andrews Avenue, Edwards, CA and the nearby area.



Figure 2.18: Aerial photograph of Edwards AFB with 7334 Andrews Avenue illustrated.

CHAPTER 3: HARDWARE DESCRIPTION

Several different types of microphones and accelerometers were placed throughout the inside and outside of the house used in this experiment. Measurements were made with these transducers on the 13th, 15th, 16th, 20th, 21st, and 22nd of June 2006. Each day there were typically two measurement sessions, where 8 to 14 booms were recorded during each session. The flights flown during these measurement sessions and the data collected are documented in Chapters 4 and 6 respectively. This chapter focuses on the transducers and other hardware used during these measurements and documents the:

- Transducers installed in the house
- Nominal transducer layout
- Data acquisition system used to acquire data
- Calibration procedures used and calibration data
- Day-to-day hardware changes made over the course of the six test days
- Day-to-day changes made to the instrumented rooms

Section 3.1: Description of the transducers used

Accelerometers were attached to the walls, windows, and ceilings in three rooms of the house (two bedrooms and the indoor subjective seating room) to measure the vibration response of the structure to the sonic boom exposure. Microphones were placed in each room in random locations to sample the resulting interior noise. In addition, several microphones were placed outside, surrounding the house, to characterize the excitation field and measure the diffraction of the boom around the house. The current manufacturers specification sheets for all the transducers, signal conditioning, and data acquisition hardware used in this test are included in Appendix D. A list of the pertinent transducer information including serial number, nominal sensitivities, and mounting location is given in Table 3.1.

A total of 171 accelerometers were placed on the walls, windows, and ceilings inside the house. Sixteen accelerometers were placed in the subjective seating area; the remaining 155 accelerometers were mounted to surfaces in the two heavily instrumented bedrooms. Accelerometers were always mounted so that the measurement direction was oriented normal to the mounting surface, where positive acceleration pointed in the direction of the room interior. Thus, only the out of plane motion of the walls, windows, and ceilings was measured during this experiment. A detailed discussion of the mounting locations and adhesive used for these accelerometers is given in Section 3.2. Various quantities of four types of accelerometers were used during this test:

Accelerometer Types Used

<u>Quantity</u>	<u>Accelerometer model</u>	<u>Sensitivity (mV/g)</u>
82	Endevco model 2250A-10	10
40	PCB Piezotronics model 333B32	100
29	PCB Piezotronics model 333B42	500
20	PCB Piezotronics model 333B52	1000

The Endevco model 2250A-10 accelerometers are lightweight 0.4 gram, ceramic shear mode accelerometers and have a nominal sensitivity of 10 mV/g. Due to the relatively low sensitivity and low mass, these accelerometers were primarily used on the ceiling and windows where response levels were expected to be high or mass loading was of concern. The PCB 333B series of accelerometers are high sensitivity, low noise ceramic shear mode accelerometers. The masses of the 333B32, B42, and B52 accelerometers are 4 grams, 7.5 grams, and 7.5 grams respectively, which are significantly higher masses than the Endevco accelerometers. Due to the higher mass, higher sensitivity, and lower noise, the PCB 333B series of accelerometers were mounted primarily on walls where mass loading was not a concern and where higher sensitivities were desired due to the lower response levels expected in the walls. All accelerometers used in this test require ICP power. The data acquisition system, documented in Section 3.3, was used to power these ICP transducers.

A total of 40 precision condenser microphones were used indoors and outdoors to sample the excitation field and indoor acoustic response. A detailed discussion of the placement of these microphones is given in the next section of this chapter. Five types of precision microphones were placed in and around the house:

Precision Microphone Types Used

<u>Quantity</u>	<u>Accelerometer model</u>	<u>Nom. Sensitivity (mV/Pa)</u>
13	Brüel and Kjær Type 4193	12.5
12	Gras model 40AQ	50
6	Gras model 40AE	50
5	Gras model 40AE-S1	50
2	Brüel and Kjær Type 4197 intensity probe	11.2

The Brüel and Kjær Type 4193 and Gras model 40AE-S1 are microphones specifically designed for low frequency acoustic measurement and are well suited for use in measuring the acoustic response of sonic booms. One Type 4193, due to the low frequency capability, was placed in each room inside the house and at several locations outside to ensure that the low frequency content of the booms was acquired in all areas of interest. Several Type 4193 and Gras model 40AE-S1 microphones were also placed at locations of interest outside the house. The Brüel and Kjær Type 4193 microphones require a capacitive power supply. Thus, several Brüel and Kjær Nexus signal conditioners were used to power these microphones. Gain was applied to the Type 4193 microphones using the Nexus signal conditioners to maximize the dynamic range of the signal measured by the data acquisition system. The gains used each day varied, and are listed in Table 3.2 and are documented in Section 3.4. It should be noted, the very low

frequency adapter Type UC0211 supplied with the Type 4193 microphones were not used during this test. Two Brüel and Kjær Type 4197 intensity probes were also used in this test to sample the intensity radiated into the room from the walls and windows. The four intensity probe microphones were powered by Nexus signal conditioners. The Gras models 40AQ and 40AE are standard frequency range microphones designed for random incidence and free field measurements respectively. It should be noted that when comparing the response linearity of the 40AQ and 40AE models, variations in the response due to incident angle only become important above a few kHz (Appendix D). Since the acoustic response due to the sonic booms both indoors and outside falls off rapidly above a few hundred Hz, the differences in the response measured by the free field and random incidence microphone should be negligible. All the Gras microphones used in this test require ICP power. The data acquisition system, documented in Section 3.3, was used to power these ICP transducers. A description of the placement of the Gras and Brüel and Kjær precision microphones is given in Section 3.2.

In addition to the precision microphones used to sample the acoustic fields inside and outside of the house, 72 PCB Piezotronics series-130 array microphones were also used to sample the near-field acoustic response of the interior walls to infer the vibrational characteristics of the walls. Two arrays were assembled and are detailed in the next section of this chapter. The microphone and preamp models used in the arrays varied and are detailed in Table 3.1. It should be noted that the specification sheets for all the PCB array microphone models were not available, but specification sheets for the majority of the series-130 microphones used are provided in Appendix D.

A spherical array of microphones¹ was also used during this test to measure the near field response of the window in the front bedroom. The sphere was conceived and designed by Earl Williams of the Naval Research Lab¹ and built by Boeing. It consisted of a stereo lithography frame that held 50 miniature electret condenser microphones, model WM-61B (Appendix D), manufactured by Panasonic. These 50 microphones were powered by signal conditioning built and provided by Boeing. The sphere was only used during the second measurement session on June 21st. Measurements of the near field pressures using the spherical array can be used to compute the intensity in a volume surrounding the sphere out to twice the sphere radius¹. Thus, the measurements made with the sphere during this experiment will be used to reconstruct the intensity radiated by the window as a result of the boom excitation. The positioning of the spherical array, and the measurement channels it was attached to, are documented in Section 3.5.

Section 3.2: Nominal transducer layout and mounting methods

The transducer layout for the indoor transducers is documented in the drawings included in Appendix E. The locations where the accelerometers and microphones were mounted are indicated by dots on the drawings of the walls, windows, ceilings, and floors of each of the three instrumented rooms. Each dot indicates a transducer location. Red dots indicate accelerometers and green dots indicate microphones. The number next to each

¹Earl G. Williams, Nicolas Valdivia, Peter C. Herdic, and Jacob Klos, "Volumetric acoustic vector intensity imager", J. Acoust. Soc. Am. 120, 1887 (2006).

dot identifies the channel number of the data acquisition system to which the transducer was connected. These channel numbers can be cross-referenced with the channel table (Table 3.1) to identify the specific transducer placed at each position. Accelerometers were always mounted so that the measurement direction was oriented normal to the mounting surface, where positive acceleration pointed in the direction of the room interior. Only one of the accelerometers was moved during the test. This was the accelerometer that was attached to channel 112 of the data acquisition system and was initially mounted to the floor in the back bedroom. The changes made to this accelerometer, and the reasons for the change are documented in Section 3.5. No other accelerometers were moved from their nominal mounting locations illustrated in Appendix E.

The accelerometers were mounted on the walls using a blue mounting wax supplied with the transducers by PCB Piezotronics. Before the first day of testing, the accelerometers were checked to ensure that the bond of accelerometer to wall was sound. Several accelerometers were remounted during this check due to mountings that had come loose. After these initial mounting problems, no other accelerometers were found to have come loose throughout the duration of the tests. Accelerometers placed on the windows were adhered to the windows using superglue instead of wax. This was due to the high outdoor temperatures that would melt wax applied to the windowpanes. Superglue was also used to mount the accelerometers to the ceilings in all three rooms. While the mounting of the transducers has been discussed in this section, wiring of the transducers to the data acquisition system is documented in Section 3.3.

In addition to the accelerometer locations, the locations of the interior microphones are indicated on the drawings of the floors of each room (Appendix E). In the floor schematic of each room, the horizontal positions of the microphones are indicated by green dots on the floor layout and the height of the microphones off of the floor is indicated in the label next to each dot. Four microphones were placed in the front bedroom, three were placed in the back bedroom, and four were placed in the indoor subjective seating room. The interior microphones placed in the two bedrooms were mounted in microphone holders that were attached to tripods (Figure 3.2) and were always oriented so that the microphone pointed up. Windscreens were not used on the interior bedroom microphones. To limit the hazards in the subjective area, the interior subjective room microphones were suspended from the ceiling and windscreens were used to protect against curious human subjects. The positions of the Gras and B&K precision microphones in each room typically did not vary from day-to-day. One exception was the microphone on channel 205 in the front bedroom. This microphone was moved outside for measurements made on June 22, 2006. This change is documented in Section 3.5. In the schematic of the indoor subjective seating area (Appendix E), the approximate locations of the chairs are also illustrated for reference. The presence of the subjects in the house during testing may have resulted in noises due to things such as shuffling of feet and coughing, both of which are sometimes audible in the recorded data. The microphones in the indoor subjective area can be used to identify these types of noises due to the presence of the subjects.

The nominal locations of the Gras and B&K precision microphones placed outside the house are illustrated in Appendix F. Some day-to-day deviation from the nominal layout of the exterior microphone is likely because, unlike the interior microphones, the exterior microphones, tripods, and ground boards were disassembled and put away each evening and re-placed each morning. This was done to avoid potential problems caused by weather and wildlife if the microphones were left outside overnight. Thus, over the six days of testing, some placement variation in the exterior microphones should be expected. No rigorous estimate of this variation was made during the testing; however, it is suspected that any variation was approximately a few inches at most.

The exterior microphones are shown in Figures 3.3 through 3.8. The exterior microphones were either affixed to the house using Velcro, held in tripods, placed on the roof, or placed on ground boards. The five roof microphones were mounted to five 6-inch square brass plates strung together using heavy cord. Each roof microphone was mounted to a separate brass plate using Velcro, and the series of brass plates were pulled onto and off of the roof each day. Microphones placed on the ground were placed in the middle of wooden ground boards, which were 24 inches square, to approximate a rigid boundary condition. All exterior microphones were fitted with 3-inch diameter windscreens except for microphones on channels 190 and 194 which were fitted with 6-inch diameter windscreens. Windscreens were cut in half for microphones that were mounted to the house or placed on ground boards to ensure that the microphone diaphragm was as close as possible to the rigid surface. In addition to windscreens, sunscreens were placed over all of the Gras microphones that were mounted on ground boards or the roof. Initial calibrations performed before the first test day identified a significant drift in the sensitivity for the Gras microphones due to a temperature increase when exposed to direct sunlight for long periods of time. The Gras microphones on the ground boards and roof were typically very hot to the touch without sunscreens, but with sunscreens were barely warm to the touch. The sensitivity of the Gras microphones was found to be significantly more stable with the sunscreens in place. The B&K microphones did not exhibit this heat related sensitivity drift because they are not as sensitive to temperature changes (Appendix D). The Gras microphones in the tripods did not require sun shades because they did not get hot since the windscreen and the microphone holder covered them.

Four microphones were placed around the outside subjective area to measure the boom response close to the subjects (Figure 3.9 and Appendix F). The presence of the subjects outside the house during testing may have resulted in noises due to things like shuffling of feet, coughing, and speaking, all of which are sometimes audible in the recorded data. The microphones in the outdoor subjective area can be used to identify the occurrence of these types of noises due to the presence of the subjects.

The acoustic arrays that were assembled from the PCB series-130 array microphones are pictured in Figures 3.10 and 3.11. The array microphones were attached to metal bars using small foam blocks (Figure 3.11). Two arrays were assembled; a horizontal array and a vertical array. The horizontal array contained 40 microphones spaced 3 inches apart. The vertical array contained 32 microphones spaced 3 inches apart. Placement of

these arrays varied from day-to-day and these placement changes are documented in Section 3.5. The data acquisition channels to which these arrays were connected are documented in Table 3.1.

Section 3.3: Data acquisition system and cabling description

A total of 288 data acquisition channels were available, most of which were used throughout the duration of testing (Table 3.1). Three National Instruments (NI) PXI chassis were connected to a single controller computer to implement this large channel count data acquisition system (Figure 3.12). Chassis 1 and 2 were 14-slot NI PXI-1044 chassis while chassis 3 was an 18-slot NI PXI-1045 (Figure 3.12). Each chassis was configured as follows:

<u>Configuration of the data acquisition chassis</u>		
<u>Chassis</u>	<u>Slot(s)</u>	<u>Hardware</u>
1	1	NI PXI-8331 Controller card
1	2	NI PXI-6653 Timing master
1	3-14	NI PXI-4472B Data acquisition cards
2	1	NI PXI-8331 Controller card
2	2	NI PXI-6653 Timing slave
2	3-14	NI PXI-4472B Data acquisition cards
3	1	NI PXI-8331 Controller card
3	2	NI PXI-6651 Timing slave
3	3-14	NI PXI-4472B Data acquisition cards

The interface connections between each PXI chassis and the controlling computer were made using a NI PXI to PCI 8331 MXI-4 copper interface kit. The timing cards in slot two in each chassis were required to distribute the sampling clock and trigger signals among the different chassis. A master oven-controlled crystal oscillator (OCOX) timing card in slot 2 of chassis 1 generated the clock and trigger signals which were then distributed to the slave timing cards in slot 2 of chassis 2 and 3. These slave timing cards were then programmed to route the clock and trigger signals to the PXI back plane for use by the 4472B cards. Synchronization benchmarks performed when initially assembling the data acquisition system illustrated very tight phase matching between channels in different chassis. Typically, the phase error between channels on different chassis was approximately 0.01 degrees at 1000 Hz when a 51,200 Hz sample rate was used. The NI 4472B data acquisition cards, instead of the standard 4427 cards, were purchased and used in this test due to a lower cutoff frequency of the high-pass filter when AC coupling is selected. The NI 4472B cards have a 0.5 Hz high-pass AC coupling filter (Appendix D). Since AC coupling must be enabled when ICP conditioning is used for ICP accelerometers and microphones, the 4472B cards were seen as offering an advantage in making measurements of sonic boom responses that contain substantial low frequency content. The 4472B cards were used to supply ICP conditioning for all the accelerometers, the Gras microphones, and the PCB 130-series

array microphones. The only transducers that were not powered by ICP conditioning from the 4472B cards were the Brüel and Kjær Type 4193 and 4197 microphones. The Type 4193 and 4197 microphones were powered by Nexus signal conditioners as discussed previously.

To sustain high time data to disk throughput rates, a RAID 5 hard drive array was implemented in the controller computer using an Areca model ARC-1220 PCI-Express x8 SATA II controller card and six 250 GB hard drives. Initial benchmarks with this storage system configured with 288 channels showed that a continuous acquisition of time data to disk at sample rates up to 80 kHz was obtainable. The amount of continuous time data that could be streamed to disk was only limited by the size of the hard drive. Above 80 kHz, the acquisition would become discontinuous after short periods of time due to data rate limits of the interface between PXI chassis and computer. For the tests documented in this report, continuous time data was acquired using sampling rates of 25.6 kHz or 51.2 kHz. Thus, there was enough headroom in disk throughput to ensure a reliable acquisition of continuous time data.

A custom Labview data acquisition program was written for use in this test. The front panel of the Labview VI used to acquire data is shown in Figure 3.13. Programming the acquisition, synchronization, and trigger requirements for the hardware configuration described above was straightforward using Labview due to the tight integration of the NI-DAQmx device drivers into Labview. A schematic of the Labview data acquisition software is illustrated in Figure 3.14. The software serves two basic functions, first the timing and triggering lines among the three different chassis were configured and second the acquisition and storage of the time data from the 4472B's were performed. The user would specify the sample rate, the number of points per ensemble, and the total number of ensembles to be acquired. A continuous acquisition was made using these settings; each ensemble of time data was stored on the RAID array as a separate file. Typically, data were recorded continuously over the course of each measurement session that lasted about one hour (described in Chapters 4 and 6).

High-density cables were used to simplify cabling of all the transducers placed inside the house. 16-channel high-density cables were connected to the NI 4472B data acquisition cards on one end (Figure 3.12) and were connected to small 16-channel breakout boxes on the other (Figure 3.15). The cable length of these high density cables running between the breakout boxes and the data acquisition system was about 60 feet. The breakout boxes were placed in the rooms near clusters of transducers. Groups of 16 transducers were wired to the breakout boxes with short, transducer specific cables (Figure 3.15). For the PCB model 333B32, 333B42, and 333B52 accelerometers, standard microdot-to-BNC cables were used to connect the transducer to the breakout box. The lengths of these cables varied from 10 feet to roughly 25 feet, and no record was made of which cables were connected to which transducers. For the Endevco accelerometers, the standard cable supplied with those transducers was used along with a microdot-to-BNC barrel connector to connect these transducers to the breakout boxes. The accelerometer wires were always taped to the mounting surface to avoid noise and vibration due to the wire hitting the wall during the boom events. The Gras microphones were wired to the

breakout boxes using 15-foot BNC cables. The Brüel and Kjær microphones were not wired to the breakout boxes placed in the rooms. Instead, LEMO cables were run from the B&K microphones in each of the three measurement rooms back to Nexus power supplies located in the equipment room. The length of these cables was nominally 90 meters. The output of the Nexus' were then wired directly to the acquisition system using 3-foot BNC cables connected to breakout boxes placed in the equipment room. All the microphones placed outside were wired individually to the data acquisition system with long runs of either Lemo (in the case of the B&K 4193 microphones) or BNC (in the case of the Gras microphones) cables that varied in length.

Section 3.4: Equipment calibrations

The data acquisition hardware used in this test was purchased new in either August 2005 or April 2006. National Instruments performed a calibration and functional test on all the data acquisition hardware prior to shipment to NASA LaRC. These calibrations were still valid at the time of this test as they did not expire until either August 2007 or April 2008.

Typically, the transducers were calibrated by either Simco, the provider of calibration services to NASA LaRC, or the manufacturer for calibration prior to this test. If this was not possible, an in-situ end-to-end calibration was performed in accordance with LMS-TD-0558 (Appendix D). For the in-situ calibrations, a PCB Piezotronics model number 394C06 accelerometer calibrator, serial number 1856, was used to calibrate the accelerometers. This calibrator outputs a 1g RMS vibration at 159.2 Hz, and automatically adjusts for different accelerometer masses. A Brüel and Kjær pistonphone Type 4228, serial number 2034885, was used for in-situ microphone calibrations. The nominal RMS output of this pistonphone is 124 dB re 20 μ Pa. For all microphone calibrations documented in this section, a pressure correction based on the ambient pressure was applied to the nominal calibration level of the pistonphone. The pressure correction was found from a Brüel and Kjær UZ-0004 pressure indicator, serial number 2034885, included with the pistonphone.

The in-situ calibrations were done while the transducers were connected to the data acquisition system described in the previous section. The software used to acquire data included a routine that would compute the RMS voltage, high-pass filtered at 70 Hz, of a selected channel. A high-pass filter was applied before the RMS voltage was computed to remove DC bias in the signal and to remove any low frequency content caused by hand holding a calibrator while performing the calibration. While either a microphone or accelerometer was excited by a calibrator, the RMS voltage was compared to the RMS output of the calibrator to determine the sensitivity of the transducer. The operator of the data acquisition system then noted the sensitivity.

Subsection 3.4.1: Accelerometer calibrations

As a spot check, 35 of the 82 Endevco 2250A-10 accelerometers were sent to Simco for calibration prior to this test. All 35 of these accelerometers were found to be in tolerance

and were given a calibration expiration of March 15, 2007. The remaining 47 Endevco 2250A-10 accelerometers used in this test had expired calibrations. Thus, all 82 of the Endevco model 2250A-10 accelerometers were calibrated in-situ at NASA LaRC using the PCB model 394C06 accelerometer calibrator. This in-situ calibration was performed by Jacob Klos and Ralph Buehrle of the Structural Acoustics Branch prior to shipment of the equipment to the house at Edwards Air Force Base. While at NASA LaRC, several 16-channel breakout boxes were connected to the data acquisition system using the 60 foot high-density cables described in Section 3.3. All 82 of the Endevco model 2250A-10 accelerometers were then connected to the breakout boxes and an in-situ end-to-end calibration was performed on each accelerometer. The sensitivities of the Endevco model 2250A-10 accelerometers listed in Table 3.1 reflect the values obtained from this calibration. These calibration values typically did not deviate significantly from the original sensitivity provided by the manufacturer at the time of purchase (Table 3.3). Typically, the percent error between the in-situ calibration and the factory calibration was less than 1 percent, and was at most 3.9 percent. Based on the close agreement between this in-situ end-to-end calibration and the factory calibration, all 82 of the Endevco transducers were deemed usable for this test.

The PCB Piezotronics model 333B32 and 333B52 accelerometers were purchased new for this test. Prior to shipping from the manufacturer, a calibration and functional test was done by the manufacturer and the sensitivities from this calibration were included with the transducers. This manufacturer calibration of the 333B32 and 333B42 accelerometers expires on approximately 04/01/2007. The PCB Piezotronics model 333B42 accelerometers were borrowed from the Systems Integration & Test Branch at NASA LaRC and were in calibration, with an expiration date of approximately 03/24/2007. Based on the above finding that the in-situ calibrated sensitivities of the Endevco 2250A-10 accelerometers did not vary significantly from the original manufacturer calibrations, an in-situ calibration was not performed on any of the PCB accelerometers. The manufacturer-supplied sensitivities for PCB 333-series accelerometers are listed in Table 3.1 and should be used.

Subsection 3.4.2: Microphone calibrations

Before this experiment, the Brüel and Kjær Type 4193 precision microphones and Nexus power supplies were sent to Simco for calibration. They were found to be in tolerance by Simco and were given a calibration expiration of approximately March 1, 2007. The Brüel and Kjær Type 2669 preamps used with the Type 4193 microphones were purchased new for this test, and were shipped in tolerance from the factory, with a calibration expiration of approximately March 1, 2007. The factory-calibrated sensitivities of the Type 4193 microphones are listed in Table 3.1. In addition, daily in-situ calibrations were performed on the B&K Type 4193 microphones once they were installed in the field.

The Gras model 40AQ microphones and corresponding preamps were purchased new in August 2005. Prior to shipping from the manufacturer, a calibration and functional test was performed by the manufacturer and the factory-calibrated sensitivity is listed in

Table 3.1. The manufacturer's calibration of these microphones and preamps expired on approximately August 15, 2006. Daily in-situ calibrations were also performed on the Gras model 40AQ microphones once they were installed in the field.

The 40AE and 40AE-S1 microphones and corresponding preamps were on loan from The Pennsylvania State University, and were not in calibration at the time of this test. However, a daily in-situ calibration was performed according to LMS-TD-0558 on all of the precision microphones, including the 40AE and 40AE-S1, as described in the next paragraph. Thus, use of the 40AE and 40AE-S1 microphones and corresponding preamps in this test can be justified based on the use and documentation of daily in-situ calibrations.

The Gras and Brüel and Kjær precision microphones were calibrated in-situ at the test house each test day using a Brüel and Kjær Type 4228 pistonphone. Both pre- and post-test calibrations were performed. During these calibrations, the sensitivities of the microphones were noted by the operator and the calibration time histories were recorded using the data acquisition system. The time histories of the daily calibrations are available for distribution in a raw format and are discussed in Chapter 6. The microphone sensitivities from these daily end-to-end calibrations are summarized in Table 3.4. The gains of the Gras microphones, powered by the NI 4472B's, could not be changed and were always unity. The Brüel and Kjær Type 4193 microphones were always calibrated using a gain of 3.16 on the Nexus power supplies. Thus, the calibrated sensitivities listed in Table 3.16 for these microphones differ from the nominal sensitivities by this gain factor. Also, the gain used to make measurements with the Type 4193 microphones was altered throughout the test to attempt to optimize the dynamic range of the data acquisition system. These gain changes applied to the Type 4193 microphones are reflected in Table 3.2. Note that there were typically two measurement sessions per day, and the gain may have varied between sessions (Table 3.2). More discussion about the different measurement sessions and documentation of the measurements that were made on any given day are included in Chapters 4 and 6. Also, the gains of the Type 4193 microphones listed in Table 3.2 are negative to reflect that a positive change in pressure results in a negative change in output voltage for these microphones, whereas, for the Gras microphones, a positive change in pressure results in a positive change in output voltage.

The calibration of the intensity probes used in this test, and the Nexus power supply used to power them, had expired prior to this test. The sensitivities of the intensity probe microphones listed in Table 3.1 reflect values obtained from an in-situ calibration prior to shipment to Edwards.

The calibration of the PCB 130-series array microphones had expired prior to this test. Thus, these microphones were calibrated in-situ in accordance with LMS-TD-0558 while at NASA LaRC prior to shipment and installation in the test house. The sensitivities of the PCB array microphones listed in Table 3.1 reflect the values obtained from this in-situ calibration. Due to the large number of PCB 130-series array microphones used in this test, daily sensitivity checks were not performed on these microphones.

Section 3.5: Day-to-day transducer placement variations

Several changes were made to some of the transducers throughout the duration of the test. All of the configuration changes are documented in Table 3.5 and are discussed below.

The PCB accelerometer model 333B52 attached to channel 112 was initially mounted to the floor in the back bedroom to sense seismic vibration. It was moved to the window in the back bedroom on June 15th and was left there for subsequent days. The measurements on June 13th demonstrated that the vibration levels of the slab flooring of the house were very low. Therefore, it was determined that the accelerometer could be better used elsewhere. On June 15th, accelerometer 112 was placed on the window, collocated with accelerometer 122 (Appendix E), to verify that the window vibration levels were above the noise floor of the Endevco accelerometers. Accelerometer 112 was mounted to the window glass at the location of accelerometer 122, and accelerometer 122 was mounted to the back of accelerometer 112.

The linear arrays of PCB array microphones (Figures 3.10 and 3.11) that were used to sense the near field acoustic responses of the walls were repeatedly moved during the test. The different positions of these arrays are illustrated in Appendix G and the daily locations of these arrays are identified in Table 3.5. Not all positions of the arrays indicated in Appendix G were used during the boom measurement sessions; some were only used during the characterization measurements documented in Chapter 5.

In addition to the movement of the linear arrays, a spherical array of microphones was placed in front of the window for the 10:56 am measurement session on June 21st (Table 3.5). For this measurement, the 50 sphere microphones were connected to channels 209 through 258 in place of the PCB series-130 microphones of the vertical and horizontal linear arrays. ICP conditioning was turned off on these channels as the sphere was powered by HAMPS signal conditioning provided by Boeing. The location of the spherical array during this measurement session is illustrated in Appendix G.

Several microphone changes were made on the final test day on June 22nd. The horizontal array of PCB 130-series microphones, channels 241 through 280, was moved outside and disassembled. The microphones were formed into an array on the street outside the house (Appendix H). The 40 microphones were placed about an inch above the surface of the street, and were spaced 8 inches apart along an east-west line along the north side of the house (Appendix H). Two microphones were placed out of order. A table in Appendix H identifies the order of the microphone channels from west-to-east along the array. One Gras and one Brüel and Kjær precision microphone (channels 177 and 207) was collocated with two of the microphones in the array, as illustrated in Appendix H. The vertical array of PCB microphones, channels 209 through 240, was not measured on June 22nd.

In addition, on June 22nd the 4 microphones in the interior subjective room (channels 177, 178, 203, and 204; Appendix E) and the 4 microphones around the exterior subjective area (channels 188, 189, 201, and 202; Appendix F) were moved to create an array east

of the house in the desert, as illustrated in Appendix H. Also, three microphones were located near the fence to identify the diffraction around the fence (Appendix H). The line of microphones formed by this array was roughly in line with the array of microphones that were placed on the roof (Appendix H). Relevant distances for the microphone placements are indicated on the photographs. It should be noted that on the 22nd the other exterior precision microphones were not moved from the nominal locations documented in Appendix F.

Section 3.6: Day-to-day room variations

Throughout the test, several changes were made to the acoustical features of the two instrumented rooms. All of the configuration changes are documented in Table 3.6 and are discussed below.

In the front bedroom, mirrors were placed on the walls and were intended to be a source of rattle (Figure 3.16a). These were removed (Figure 3.16b) during some of the test sessions to see if changes in the interior acoustic response could be detected when comparing data taken with and without the mirrors mounted. However, given the amount of rattle from the window in the west wall of the front bedroom, it is believed detection of response changes caused by removal of these mirrors is unlikely.

In the back bedroom, the window on the east wall was partly opened about 12 inches for some of the test sessions (Figure 3.17 and Table 3.6). For these tests with the windows open, the intensity probes were positioned so that one probe was in front of the open window and the other was in front of the closed window (Figure 3.17).

As documented in Chapter 2, foam mattress pads were placed in the front and back bedrooms to increase the acoustic absorption of these rooms. To investigate the influence of changes to the acoustic absorption, four of the mattress pads were removed from the front bedroom to decrease the absorption in this room (Figure 3.18). These four mattress pads were then placed in the back bedroom to increase the absorption in this room (Figure 3.19). As stated in Chapter 2, reverberation time measurements were made in the bedrooms to characterize the acoustic absorption with the nominal foam pad layout. These same reverberation time measurements were repeated for this altered foam layout and are documented in Chapter 5. The configuration of the foam pads in each bedroom for each test session is summarized in Table 3.6.

Typically, each test day consisted of two measurement sessions, each approximately 45 minutes in duration, with roughly a 45-minute pause between the two sessions. The temperature of the HVAC system was set very low in the mornings to cool the house interior down before the start of the first measurement session. Also, the HVAC system was run in between the first and second measurement sessions to maintain a reasonably consistent interior temperature from session-to-session. Consequently, while the HVAC system was turned off during testing and the temperature outside was fairly high, neither bedroom appeared to increase in temperature significantly during the measurement sessions. Unfortunately, no daily measurements were made of the actual temperature

indoor temperature. However, the temperature of the two rooms during testing was estimated to be roughly 70° F from one measurement that was taken using an un-calibrated thermometer.

Table 3.1: List of transducers, locations, and data acquisition channel mapping

Channel	Transducer Type	Transducer Name	Transducer Manufacturer and Model	Transducer Serial Number	Preamp Model	Preamp Serial Number	Amplifier Number	Amplifier Channel	Location Description	Calibrated Sensitivity	Sensitivity Units	Type of Calibration
1	Mic	GN Mic #01	Gras 40AQ	48291	26CA	58461	NI ICP	N/A	Front Bedroom	Nom: 50.82	mV/Pa	See Table 3.4
2	Mic	GN Mic #02	Gras 40AQ	48292	26CA	58462	NI ICP	N/A	Front Bedroom	Nom: 51.66	mV/Pa	See Table 3.4
3	Mic	GN Mic #03	Gras 40AQ	48293	26CA	58463	NI ICP	N/A	Front Bedroom	Nom: 51.64	mV/Pa	See Table 3.4
4	Accel	333B32 #24	PCB 333B32	31314	N/A	N/A	NI ICP	N/A	Front Bedroom, Bath Wall	108.7	mV/g	Manufacturer
5	Accel	333B52 #04	PCB 333B52	31598	N/A	N/A	NI ICP	N/A	Front Bedroom, Bath Wall	941	mV/g	Manufacturer
6	Accel	333B32 #23	PCB 333B32	30510	N/A	N/A	NI ICP	N/A	Front Bedroom, Bath Wall	96.6	mV/g	Manufacturer
7	Accel	333B42 #01	PCB 333B42	14728	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	526	mV/g	Manufacturer
8	Accel	333B42 #02	PCB 333B42	14732	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	510	mV/g	Manufacturer
9	Accel	333B32 #01	PCB 333B32	29200	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	98.8	mV/g	Manufacturer
10	Accel	333B32 #02	PCB 333B32	29201	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	97.4	mV/g	Manufacturer
11	Accel	333B32 #03	PCB 333B32	29202	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	96.4	mV/g	Manufacturer
12	Accel	333B32 #04	PCB 333B32	29203	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	97.2	mV/g	Manufacturer
13	Accel	333B32 #05	PCB 333B32	30033	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	97.6	mV/g	Manufacturer
14	Accel	333B32 #06	PCB 333B32	30034	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	98.6	mV/g	Manufacturer
15	Accel	333B32 #07	PCB 333B32	30035	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	99.2	mV/g	Manufacturer
16	Accel	333B32 #08	PCB 333B32	30036	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	99.7	mV/g	Manufacturer
17	Accel	333B32 #09	PCB 333B32	30037	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	98.7	mV/g	Manufacturer
18	Accel	333B32 #10	PCB 333B32	30038	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	100.4	mV/g	Manufacturer
19	Accel	333B32 #11	PCB 333B32	30039	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	99	mV/g	Manufacturer
20	Accel	333B42 #04	PCB 333B42	14739	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	516	mV/g	Manufacturer
21	Accel	333B42 #03	PCB 333B42	14735	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	546	mV/g	Manufacturer
22	Accel	Endevco #17	Endevco 2250a-10	12943	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.11	mV/g	Pretest In-situ
23	Accel	Endevco #18	Endevco 2250a-10	12946	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.17	mV/g	Pretest In-situ
24	Accel	Endevco #19	Endevco 2250a-10	12954	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.17	mV/g	Pretest In-situ
25	Accel	Endevco #20	Endevco 2250a-10	12956	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.12	mV/g	Pretest In-situ
26	Accel	Endevco #21	Endevco 2250a-10	12957	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.16	mV/g	Pretest In-situ
27	Accel	Endevco #22	Endevco 2250a-10	13094	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.09	mV/g	Pretest In-situ
28	Accel	Endevco #23	Endevco 2250a-10	13098	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.09	mV/g	Pretest In-situ
29	Accel	Endevco #24	Endevco 2250a-10	13102	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.17	mV/g	Pretest In-situ
30	Accel	Endevco #25	Endevco 2250a-10	13109	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.11	mV/g	Pretest In-situ
31	Accel	Endevco #26	Endevco 2250a-10	13113	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.03	mV/g	Pretest In-situ
32	Accel	Endevco #27	Endevco 2250a-10	13115	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Window	10.47	mV/g	Pretest In-situ
33	Accel	333B42 #05	PCB 333B42	14740	N/A	N/A	NI ICP	N/A	Front Bedroom, Front Wall	517	mV/g	Manufacturer
34	Accel	333B52 #01	PCB 333B52	31595	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	987	mV/g	Manufacturer
35	Accel	333B42 #06	PCB 333B42	14741	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	492	mV/g	Manufacturer
36	Accel	333B42 #07	PCB 333B42	14743	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	501	mV/g	Manufacturer
37	Accel	333B42 #08	PCB 333B42	14746	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	544	mV/g	Manufacturer
38	Accel	333B42 #09	PCB 333B42	14748	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	515	mV/g	Manufacturer
39	Accel	333B32 #12	PCB 333B32	30040	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	97.4	mV/g	Manufacturer
40	Accel	333B32 #13	PCB 333B32	30071	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	98.4	mV/g	Manufacturer
41	Accel	333B32 #14	PCB 333B32	30072	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	100.3	mV/g	Manufacturer
42	Accel	333B32 #15	PCB 333B32	30073	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	98.5	mV/g	Manufacturer
43	Accel	333B32 #16	PCB 333B32	30074	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	97.6	mV/g	Manufacturer
44	Accel	Endevco #28	Endevco 2250a-10	13133	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.05	mV/g	Pretest In-situ
45	Accel	Endevco #29	Endevco 2250a-10	13821	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.05	mV/g	Pretest In-situ
46	Accel	Endevco #30	Endevco 2250a-10	13848	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.08	mV/g	Pretest In-situ
47	Accel	Endevco #31	Endevco 2250a-10	13857	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.16	mV/g	Pretest In-situ
48	Accel	Endevco #32	Endevco 2250a-10	13858	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.06	mV/g	Pretest In-situ
49	Accel	Endevco #33	Endevco 2250a-10	13860	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.04	mV/g	Pretest In-situ
50	Accel	Endevco #34	Endevco 2250a-10	13862	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.14	mV/g	Pretest In-situ
51	Accel	Endevco #35	Endevco 2250a-10	13875	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Window	10.06	mV/g	Pretest In-situ
52	Accel	333B32 #17	PCB 333B32	30075	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	96.8	mV/g	Manufacturer
53	Accel	333B32 #18	PCB 333B32	30076	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	99.6	mV/g	Manufacturer
54	Accel	333B32 #19	PCB 333B32	30077	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	99.8	mV/g	Manufacturer
55	Accel	333B42 #10	PCB 333B42	14749	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	479	mV/g	Manufacturer
56	Accel	333B32 #20	PCB 333B32	30078	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	99.1	mV/g	Manufacturer

Table 3.1: Continued

Channel	Transducer Type	Transducer Name	Transducer Manufacturer and Model	Transducer Serial Number	Preamp Model	Preamp Serial Number	Amplifier Serial Number	Amplifier Channel	Location Description	Calibrated Sensitivity	Sensitivity Units	Type of Calibration
57	Accel	33B32 #21	PCB 333B32	30079	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	99.8	mV/g	Manufacturer
58	Accel	33B32 #22	PCB 333B32	30080	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	99.6	mV/g	Manufacturer
59	Accel	33B52 #02	PCB 333B52	31596	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	952	mV/g	Manufacturer
60	Accel	33B52 #03	PCB 333B52	31597	N/A	N/A	NI ICP	N/A	Front Bedroom, Side Wall	1011	mV/g	Manufacturer
61	Mic	GN Mic #04	Gras 40AQ	48294	26CA	58464	NI ICP	N/A	Back Bedroom	Nom.: 50.99	mV/Pa	See Table 3.4
62	Mic	GN Mic #05	Gras 40AQ	48295	26CA	58465	NI ICP	N/A	Back Bedroom	Nom.: 49.29	mV/Pa	See Table 3.4
63	Accel	Endevco #55	Endevco 2250a-10	12931	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	10.11	mV/g	Pretest In-situ
64	Accel	Endevco #56	Endevco 2250a-10	12932	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	10	mV/g	Pretest In-situ
65	Accel	33B42 #26	PCB 333B42	14955	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	531	mV/g	Manufacturer
66	Accel	33B52 #14	PCB 333B52	31608	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	952	mV/g	Manufacturer
67	Accel	33B42 #21	PCB 333B42	14767	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	484	mV/g	Manufacturer
68	Accel	33B42 #25	PCB 333B42	14952	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	506	mV/g	Manufacturer
69	Accel	33B42 #22	PCB 333B42	14768	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	470	mV/g	Manufacturer
70	Accel	33B52 #15	PCB 333B52	31609	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	966	mV/g	Manufacturer
71	Accel	33B42 #24	PCB 333B42	14951	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	515	mV/g	Manufacturer
72	Accel	33B32 #08	PCB 333B32	31618	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	107.7	mV/g	Manufacturer
73	Accel	33B42 #23	PCB 333B42	14949	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	509	mV/g	Manufacturer
74	Accel	33B32 #09	PCB 333B32	31619	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	106.6	mV/g	Manufacturer
75	Accel	33B52 #13	PCB 333B52	31607	N/A	N/A	NI ICP	N/A	Back Bedroom, Front Wall	955	mV/g	Manufacturer
76	Accel	33B52 #05	PCB 333B52	31599	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	975	mV/g	Manufacturer
77	Accel	33B42 #11	PCB 333B42	14751	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	482	mV/g	Manufacturer
78	Accel	33B52 #07	PCB 333B52	31601	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	976	mV/g	Manufacturer
79	Accel	33B42 #12	PCB 333B42	14754	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	520	mV/g	Manufacturer
80	Accel	33B32 #29	PCB 333B32	31319	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	99.5	mV/g	Manufacturer
81	Accel	33B32 #00	PCB 333B32	31320	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	106.6	mV/g	Manufacturer
82	Accel	33B32 #31	PCB 333B32	31321	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	96.8	mV/g	Manufacturer
83	Accel	33B32 #08	PCB 333B32	31602	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	991	mV/g	Manufacturer
84	Accel	33B32 #26	PCB 333B32	31316	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	106.5	mV/g	Manufacturer
85	Accel	33B52 #06	PCB 333B52	31600	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	981	mV/g	Manufacturer
86	Accel	33B32 #28	PCB 333B32	31318	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	106.9	mV/g	Manufacturer
87	Accel	33B32 #25	PCB 333B32	31315	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	102.2	mV/g	Manufacturer
88	Accel	Endevco #39	Endevco 2250a-10	12879	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	9.97	mV/g	Pretest In-situ
89	Accel	Endevco #40	Endevco 2250a-10	12899	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	10.41	mV/g	Pretest In-situ
90	Accel	Endevco #38	Endevco 2250a-10	12878	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	10.09	mV/g	Pretest In-situ
91	Accel	Endevco #36	Endevco 2250a-10	12858	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	10.07	mV/g	Pretest In-situ
92	Accel	Endevco #37	Endevco 2250a-10	12859	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	10	mV/g	Pretest In-situ
93	Accel	Endevco #43	Endevco 2250a-10	12902	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	9.93	mV/g	Pretest In-situ
94	Accel	Endevco #41	Endevco 2250a-10	12900	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	10.08	mV/g	Pretest In-situ
95	Accel	Endevco #42	Endevco 2250a-10	12901	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Window	10.11	mV/g	Pretest In-situ
96	Accel	33B32 #04	PCB 333B32	31324	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	100.5	mV/g	Manufacturer
97	Accel	33B32 #03	PCB 333B32	31323	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	99.1	mV/g	Manufacturer
98	Accel	33B32 #02	PCB 333B32	31322	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	102.6	mV/g	Manufacturer
99	Accel	33B42 #13	PCB 333B42	14755	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	495	mV/g	Manufacturer
100	Accel	33B32 #27	PCB 333B32	31317	N/A	N/A	NI ICP	N/A	Back Bedroom, Side Wall	99.8	mV/g	Manufacturer
101	Accel	33B52 #11	PCB 333B52	31605	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	951	mV/g	Manufacturer
102	Accel	33B52 #12	PCB 333B52	31606	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	961	mV/g	Manufacturer
103	Accel	33B52 #09	PCB 333B52	31603	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	986	mV/g	Manufacturer
104	Accel	33B42 #17	PCB 333B42	14761	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	528	mV/g	Manufacturer
105	Accel	33B42 #18	PCB 333B42	14764	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	512	mV/g	Manufacturer
106	Accel	33B52 #10	PCB 333B52	31604	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	964	mV/g	Manufacturer
107	Accel	33B42 #19	PCB 333B42	14765	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	495	mV/g	Manufacturer
108	Accel	33B42 #20	PCB 333B42	14766	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	487	mV/g	Manufacturer
109	Accel	33B32 #05	PCB 333B32	31325	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	100.1	mV/g	Manufacturer
110	Accel	33B52 #06	PCB 333B52	31616	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	99.3	mV/g	Manufacturer
111	Accel	33B32 #37	PCB 333B32	31617	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	100.9	mV/g	Manufacturer
112	Accel	33B52 #17	PCB 333B52	31611	N/A	N/A	NI ICP	N/A	Back Bedroom, Floor	985	mV/g	Manufacturer
113	Accel	33B42 #16	PCB 333B42	14760	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	496	mV/g	Manufacturer
114	Accel	33B42 #14	PCB 333B42	14756	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	514	mV/g	Manufacturer

Table 3.1: Continued

Channel	Transducer Type	Transducer Name	Transducer Manufacturer and Model	Transducer Serial Number	Preamplifier Model	Preamplifier Serial Number	Amplifier Channel	Location Description	Calibrated Sensitivity	Sensitivity Units	Type of Calibration	
115	Accel	333B42 #15	PCB 333B42	14758	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Wall	485	mV/g	Manufacturer
116	Accel	333B32 #40	PCB 333B32	31621	N/A	N/A	NI ICP	N/A	Back Bedroom, Closet Wall	97.7	mV/g	Manufacturer
117	Accel	333B52 #16	PCB 333B52	31610	N/A	N/A	NI ICP	N/A	Back Bedroom, Closet Wall	97.1	mV/g	Manufacturer
118	Accel	Endevco #44	Endevco 2250a-10	12903	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10.07	mV/g	Pretest In-situ
119	Accel	Endevco #45	Endevco 2250a-10	12904	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10.07	mV/g	Pretest In-situ
120	Accel	Endevco #46	Endevco 2250a-10	12905	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	9.96	mV/g	Pretest In-situ
121	Accel	Endevco #47	Endevco 2250a-10	12910	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	9.9	mV/g	Pretest In-situ
122	Accel	Endevco #48	Endevco 2250a-10	12912	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10.33	mV/g	Pretest In-situ
123	Accel	Endevco #49	Endevco 2250a-10	12913	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10.23	mV/g	Pretest In-situ
124	Accel	Endevco #50	Endevco 2250a-10	12914	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10.11	mV/g	Pretest In-situ
125	Accel	Endevco #51	Endevco 2250a-10	12915	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10	mV/g	Pretest In-situ
126	Accel	Endevco #52	Endevco 2250a-10	12916	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	9.99	mV/g	Pretest In-situ
127	Accel	Endevco #53	Endevco 2250a-10	12919	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10	mV/g	Pretest In-situ
128	Accel	Endevco #54	Endevco 2250a-10	12928	N/A	N/A	NI ICP	N/A	Back Bedroom, Back Window	10.16	mV/g	Pretest In-situ
129	Accel	Endevco #01	Endevco 2250a-10	EC36	N/A	N/A	NI ICP	N/A	Subjective Room	10.1	mV/g	Pretest In-situ
130	Accel	Endevco #02	Endevco 2250a-10	11075	N/A	N/A	NI ICP	N/A	Subjective Room	10.1	mV/g	Pretest In-situ
131	Accel	Endevco #03	Endevco 2250a-10	12862	N/A	N/A	NI ICP	N/A	Subjective Room	10.2	mV/g	Pretest In-situ
132	Accel	Endevco #04	Endevco 2250a-10	12865	N/A	N/A	NI ICP	N/A	Subjective Room	9.8	mV/g	Pretest In-situ
133	Accel	Endevco #05	Endevco 2250a-10	12870	N/A	N/A	NI ICP	N/A	Subjective Room	9.9	mV/g	Pretest In-situ
134	Accel	Endevco #06	Endevco 2250a-10	12873	N/A	N/A	NI ICP	N/A	Subjective Room	10	mV/g	Pretest In-situ
135	Accel	Endevco #07	Endevco 2250a-10	12877	N/A	N/A	NI ICP	N/A	Subjective Room	9.92	mV/g	Pretest In-situ
136	Accel	Endevco #08	Endevco 2250a-10	12891	N/A	N/A	NI ICP	N/A	Subjective Room	10.09	mV/g	Pretest In-situ
137	Accel	Endevco #09	Endevco 2250a-10	12920	N/A	N/A	NI ICP	N/A	Subjective Room	10.33	mV/g	Pretest In-situ
138	Accel	Endevco #10	Endevco 2250a-10	12921	N/A	N/A	NI ICP	N/A	Subjective Room	10	mV/g	Pretest In-situ
139	Accel	Endevco #11	Endevco 2250a-10	12922	N/A	N/A	NI ICP	N/A	Subjective Room	10.04	mV/g	Pretest In-situ
140	Accel	Endevco #12	Endevco 2250a-10	12926	N/A	N/A	NI ICP	N/A	Subjective Room	10.26	mV/g	Pretest In-situ
141	Accel	Endevco #13	Endevco 2250a-10	12927	N/A	N/A	NI ICP	N/A	Subjective Room	10.32	mV/g	Pretest In-situ
142	Accel	Endevco #14	Endevco 2250a-10	12937	N/A	N/A	NI ICP	N/A	Subjective Room	10.04	mV/g	Pretest In-situ
143	Accel	Endevco #15	Endevco 2250a-10	12939	N/A	N/A	NI ICP	N/A	Subjective Room	10.01	mV/g	Pretest In-situ
144	Accel	Endevco #16	Endevco 2250a-10	12942	N/A	N/A	NI ICP	N/A	Subjective Room	10.27	mV/g	Pretest In-situ
145	Accel	Endevco #70	Endevco 2250a-10	14182	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.1	mV/g	Pretest In-situ
146	Accel	Endevco #71	Endevco 2250a-10	14183	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.09	mV/g	Pretest In-situ
147	Accel	Endevco #72	Endevco 2250a-10	14189	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	9.98	mV/g	Pretest In-situ
148	Accel	Endevco #73	Endevco 2250a-10	14190	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.02	mV/g	Pretest In-situ
149	Accel	333B52 #20	PCB 333B52	31614	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	960	mV/g	Manufacturer
150	Accel	333B52 #19	PCB 333B52	31613	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	959	mV/g	Manufacturer
151	Accel	333B42 #28	PCB 333B42	14957	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	534	mV/g	Manufacturer
152	Accel	Endevco #74	Endevco 2250a-10	14206	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.18	mV/g	Pretest In-situ
153	Accel	Endevco #75	Endevco 2250a-10	11136	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.22	mV/g	Pretest In-situ
154	Accel	Endevco #76	Endevco 2250a-10	11061	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.03	mV/g	Pretest In-situ
155	Accel	Endevco #77	Endevco 2250a-10	11079	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.19	mV/g	Pretest In-situ
156	Accel	Endevco #78	Endevco 2250a-10	11083	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	9.94	mV/g	Pretest In-situ
157	Accel	Endevco #79	Endevco 2250a-10	11096	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	9.97	mV/g	Pretest In-situ
158	Accel	Endevco #80	Endevco 2250a-10	11101	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10	mV/g	Pretest In-situ
159	Accel	Endevco #81	Endevco 2250a-10	11111	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.42	mV/g	Pretest In-situ
160	Accel	Endevco #82	Endevco 2250a-10	11121	N/A	N/A	NI ICP	N/A	Back Bedroom, Ceiling	10.21	mV/g	Pretest In-situ
161	Accel	Endevco #57	Endevco 2250a-10	12934	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.16	mV/g	Pretest In-situ
162	Accel	Endevco #58	Endevco 2250a-10	12935	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.12	mV/g	Pretest In-situ
163	Accel	Endevco #59	Endevco 2250a-10	12941	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	9.96	mV/g	Pretest In-situ
164	Accel	Endevco #60	Endevco 2250a-10	12945	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.08	mV/g	Pretest In-situ
165	Accel	Endevco #61	Endevco 2250a-10	12992	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.09	mV/g	Pretest In-situ
166	Accel	Endevco #62	Endevco 2250a-10	13093	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.16	mV/g	Pretest In-situ
167	Accel	Endevco #63	Endevco 2250a-10	13449	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.22	mV/g	Pretest In-situ
168	Accel	333B42 #27	PCB 333B42	14956	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	524	mV/g	Manufacturer
169	Accel	Endevco #64	Endevco 2250a-10	13807	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.15	mV/g	Pretest In-situ
170	Accel	Endevco #65	Endevco 2250a-10	13847	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.2	mV/g	Pretest In-situ
171	Accel	333B52 #18	PCB 333B52	31612	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	951	mV/g	Manufacturer
172	Accel	Endevco #66	Endevco 2250a-10	14121	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.13	mV/g	Pretest In-situ

Table 3.1: Continued

Channel	Transducer Type	Transducer Name	Manufacturer and Model	Transducer Serial Number	Preamp Model	Preamp Serial Number	Amplifier Serial Number	Amplifier Channel	Location Description	Calibrated Sensitivity	Sensitivity Units	Type of Calibration
173	Accel	Endevco #67	Endevco 2250a-10	14142	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.14	mV/g	Pretest In-situ
174	Accel	Endevco #68	Endevco 2250a-10	14143	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	9.96	mV/g	Pretest In-situ
175	Accel	Endevco #69	Endevco 2250a-10	14160	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	10.15	mV/g	Pretest In-situ
176	Accel	333B42 #29	PCB 333B42	14958	N/A	N/A	NI ICP	N/A	Front Bedroom, Ceiling	547	mV/g	Manufacturer
177	Mic	GN Mic #06	Gras 40AQ	48296	26CA	58466	NI ICP	N/A	Subjective Room	Nom.: 53.38	mV/Pa	See Table 3.4
178	Mic	GN Mic #07	Gras 40AQ	48297	26CA	58467	NI ICP	N/A	Subjective Room	Nom.: 47.98	mV/Pa	See Table 3.4
179	Mic	GPL Mic #1	Gras 40AE-S1	60765	26CA	48686	NI ICP	N/A	Roof	Nom.: 50	mV/Pa	See Table 3.4
180	Mic	GN Mic #08	Gras 40AQ	48298	26CA	58468	NI ICP	N/A	Roof	Nom.: 50.79	mV/Pa	See Table 3.4
181	Mic	GP Mic #1	Gras 40AE	49357	26CA	43250	NI ICP	N/A	Roof	Nom.: 50	mV/Pa	See Table 3.4
182	Mic	GN Mic #09	Gras 40AQ	48299	26CA	58469	NI ICP	N/A	Roof	Nom.: 46.49	mV/Pa	See Table 3.4
183	Mic	GPL Mic #2	Gras 40AE-S1	60767	26CA	48694	NI ICP	N/A	Roof	Nom.: 50	mV/Pa	See Table 3.4
184	Mic	GPL Mic #3	Gras 40AE-S1	60769	26CA	48746	NI ICP	N/A	Front Yard, Head Height	Nom.: 50	mV/Pa	See Table 3.4
185	Mic	GN Mic #10	Gras 40AQ	48300	26CA	58470	NI ICP	N/A	Front Yard, Head Height	Nom.: 52.07	mV/Pa	See Table 3.4
186	Mic	Gras 40AE	Gras 40AE	49379	26CA	48692	NI ICP	N/A	Front Yard, Ground	Nom.: 50	mV/Pa	See Table 3.4
187	Mic	GP Mic #2	Gras 40AE	49691	26CA	48687	NI ICP	N/A	Front Yard, Ground	Nom.: 50	mV/Pa	See Table 3.4
188	Mic	GN Mic #11	Gras 40AQ	48301	26CA	58471	NI ICP	N/A	Outside Subjective Area	Nom.: 51.75	mV/Pa	See Table 3.4
189	Mic	GN Mic #12	Gras 40AQ	48302	26CA	58472	NI ICP	N/A	Outside Subjective Area	Nom.: 49.08	mV/Pa	See Table 3.4
190	Mic	GPL Mic #4	Gras 40AE-S1	60770	26CA	48683	NI ICP	N/A	Outside Far Field	Nom.: 50	mV/Pa	See Table 3.4
191	Mic	GPL Mic #5	Gras 40AE-S1	60775	26CA	48697	NI ICP	N/A	Back Yard, Ground	Nom.: 50	mV/Pa	See Table 3.4
192	Mic	GP Mic #4	Gras 40AE	49693	26CA	48691	NI ICP	N/A	Back Yard, Ground	Nom.: 50	mV/Pa	See Table 3.4
193	Mic	GPL Mic #6	Gras 40AE-S1	60777	26CA	47672	NI ICP	N/A	Back Yard, Head Height	Nom.: 50	mV/Pa	See Table 3.4
194	Mic	B Mic #01	B&K Type 4193	2151208	B&K Type 2669	2526878	Nexus 1	1	Back Yard, Ground	Nom.: 13.5	mV/Pa	See Table 3.4
195	Mic	B Mic #02	B&K Type 4193	2151223	B&K Type 2669	2526877	Nexus 2	2	Back Yard, Head Height	Nom.: 14	mV/Pa	See Table 3.4
196	Mic	B Mic #03	B&K Type 4193	2151225	B&K Type 2669	2526883	Nexus 3	3	Back Yard, Ground	Nom.: 11.9	mV/Pa	See Table 3.4
197	Mic	B Mic #04	B&K Type 4193	2151227	B&K Type 2669	2526885	Nexus 4	4	Back Yard, Head Height	Nom.: 13.5	mV/Pa	See Table 3.4
198	Mic	B Mic #05	B&K Type 4193	2151232	B&K Type 2669	1828322	Nexus 1	1	Front Yard, Ground	Nom.: 13.8	mV/Pa	See Table 3.4
199	Mic	B Mic #06	B&K Type 4193	2305432	B&K Type 2669	2526881	Nexus 2	2	Front Yard, Ground	Nom.: 12.86	mV/Pa	See Table 3.4
200	Mic	B Mic #07	B&K Type 4193	2305433	B&K Type 2669	1865306	Nexus 3	3	Front Yard, Head Height	Nom.: 14.4	mV/Pa	See Table 3.4
201	Mic	B Mic #08	B&K Type 4193	2305435	B&K Type 2669	2526884	Nexus 4	4	Outside Subjective Area	Nom.: 13.4	mV/Pa	See Table 3.4
202	Mic	B Mic #09	B&K Type 4193	2305436	B&K Type 2669	2351710	Nexus 1	1	Outside Subjective Area	Nom.: 13.8	mV/Pa	See Table 3.4
203	Mic	B Mic #10	B&K Type 4193	2305437	B&K Type 2669	2526882	Nexus 2	2	Subjective Room	Nom.: 14.2	mV/Pa	See Table 3.4
204	Mic	B Mic #11	B&K Type 4193	2305438	B&K Type 2669	2526876	Nexus 3	3	Subjective Room	Nom.: 12.9	mV/Pa	See Table 3.4
205	Mic	B Mic #12	B&K Type 4193	2305439	B&K Type 2669	2526880	Nexus 4	4	Front Bedroom	Nom.: 13	mV/Pa	See Table 3.4
206	Mic	B Mic #13	B&K Type 4193	2305441	B&K Type 2669	2352747	Nexus 1	1	Back Bedroom	Nom.: 13.5	mV/Pa	See Table 3.4
207	Other	RIG Time Signal	N/A	N/A	N/A	N/A	None	N/A	Equipment Room	1	N/A	N/A
208	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
209	Array Mic	PCB Mic #01	TT130C21	12124	N/A	N/A	NI ICP	N/A	Movable, Vertical Array	18.9	mV/Pa	Pretest In-situ
210	Array Mic	PCB Mic #02	130M01	2715	130P11	12951	NI ICP	N/A	Movable, Vertical Array	25.1	mV/Pa	Pretest In-situ
211	Array Mic	PCB Mic #03	130A10	5204	130P11	12957	NI ICP	N/A	Movable, Vertical Array	23.9	mV/Pa	Pretest In-situ
212	Array Mic	PCB Mic #04	130B10	8824	130P11	9064	NI ICP	N/A	Movable, Vertical Array	17.6	mV/Pa	Pretest In-situ
213	Array Mic	PCB Mic #05	130B10	8814	130P11	9051	NI ICP	N/A	Movable, Vertical Array	18.6	mV/Pa	Pretest In-situ
214	Array Mic	PCB Mic #06	130A10	2920	130P11	5259	NI ICP	N/A	Movable, Vertical Array	25.6	mV/Pa	Pretest In-situ
215	Array Mic	PCB Mic #07	130A10	5214	130P11	5264	NI ICP	N/A	Movable, Vertical Array	17.9	mV/Pa	Pretest In-situ
216	Array Mic	PCB Mic #08	130B10	8827	130P11	9061	NI ICP	N/A	Movable, Vertical Array	19.3	mV/Pa	Pretest In-situ
217	Array Mic	PCB Mic #09	130B10	8840	130P11	9069	NI ICP	N/A	Movable, Vertical Array	24.8	mV/Pa	Pretest In-situ
218	Array Mic	PCB Mic #10	130M01	2719	130P11	12941	NI ICP	N/A	Movable, Vertical Array	20.6	mV/Pa	Pretest In-situ
219	Array Mic	PCB Mic #11	130A10	5095	130P11	12966	NI ICP	N/A	Movable, Vertical Array	18	mV/Pa	Pretest In-situ
220	Array Mic	PCB Mic #12	130A10	2971	130P11	16465	NI ICP	N/A	Movable, Vertical Array	23.1	mV/Pa	Pretest In-situ
221	Array Mic	PCB Mic #13	130M01	2721	130P11	12946	NI ICP	N/A	Movable, Vertical Array	28.6	mV/Pa	Pretest In-situ
222	Array Mic	PCB Mic #14	130A10	5148	130P11	12956	NI ICP	N/A	Movable, Vertical Array	31.4	mV/Pa	Pretest In-situ
223	Array Mic	PCB Mic #15	TT130C21	12188	N/A	N/A	NI ICP	N/A	Movable, Vertical Array	18.6	mV/Pa	Pretest In-situ
224	Array Mic	PCB Mic #16	TT130C21	12095	N/A	N/A	NI ICP	N/A	Movable, Vertical Array	25.3	mV/Pa	Pretest In-situ
225	Array Mic	PCB Mic #17	130A10	5111	130P11	10749	NI ICP	N/A	Movable, Vertical Array	22.8	mV/Pa	Pretest In-situ
226	Array Mic	PCB Mic #18	130A10	5220	130P11	12963	NI ICP	N/A	Movable, Vertical Array	21.6	mV/Pa	Pretest In-situ
227	Array Mic	PCB Mic #19	130M01	2720	130P11	10551	NI ICP	N/A	Movable, Vertical Array	25.5	mV/Pa	Pretest In-situ
228	Array Mic	PCB Mic #20	130A10	5201	130P11	12965	NI ICP	N/A	Movable, Vertical Array	23.9	mV/Pa	Pretest In-situ
229	Array Mic	PCB Mic #21	130A10	5200	130P11	12962	NI ICP	N/A	Movable, Vertical Array	21.7	mV/Pa	Pretest In-situ
230	Array Mic	PCB Mic #22	130A10	2972	130P11	10559	NI ICP	N/A	Movable, Vertical Array	17.1	mV/Pa	Pretest In-situ

Table 3.1: Concluded

Channel	Transducer Type	Transducer Name	Transducer Manufacturer and Model	Transducer Serial Number	Preamp Model	Preamp Serial Number	Amplifier Serial Number	Amplifier Channel	Location Description	Calibrated Sensitivity	Sensitivity Units	Type of Calibration
231	Array Mic	PCB Mic #23	130A10	2699	130P11	12948	NI ICP	N/A	Movable, Vertical Array	26.2	mV/Pa	Pretest In-situ
232	Array Mic	PCB Mic #24	130A10	2751	130P11	12955	NI ICP	N/A	Movable, Vertical Array	18.6	mV/Pa	Pretest In-situ
233	Array Mic	PCB Mic #25	130A10	2758	130P11	12949	NI ICP	N/A	Movable, Vertical Array	19.6	mV/Pa	Pretest In-situ
234	Array Mic	PCB Mic #26	130A10	2754	130P11	12958	NI ICP	N/A	Movable, Vertical Array	17.9	mV/Pa	Pretest In-situ
235	Array Mic	PCB Mic #27	130A10	5203	130P11	12942	NI ICP	N/A	Movable, Vertical Array	23.1	mV/Pa	Pretest In-situ
236	Array Mic	PCB Mic #28	130A10	2930	130P11	10719	NI ICP	N/A	Movable, Vertical Array	24.1	mV/Pa	Pretest In-situ
237	Array Mic	PCB Mic #29	T130C21	12191	N/A	N/A	NI ICP	N/A	Movable, Vertical Array	28.7	mV/Pa	Pretest In-situ
238	Array Mic	PCB Mic #30	T130C21	12123	N/A	N/A	NI ICP	N/A	Movable, Vertical Array	24.8	mV/Pa	Pretest In-situ
239	Array Mic	PCB Mic #31	130M01	2716	130P11	12954	NI ICP	N/A	Movable, Vertical Array	17.2	mV/Pa	Pretest In-situ
240	Array Mic	PCB Mic #32	130A10	5131	130P11	12960	NI ICP	N/A	Movable, Vertical Array	24.8	mV/Pa	Pretest In-situ
241	Array Mic	PCB Mic #33	130A10	2927	130P11	12961	NI ICP	N/A	Movable, Horizontal Array	21.9	mV/Pa	Pretest In-situ
242	Array Mic	PCB Mic #34	130M01	2717	130P11	12943	NI ICP	N/A	Movable, Horizontal Array	19.1	mV/Pa	Pretest In-situ
243	Array Mic	PCB Mic #35	130A10	5211	130P11	12950	NI ICP	N/A	Movable, Horizontal Array	20.4	mV/Pa	Pretest In-situ
244	Array Mic	PCB Mic #36	130A10	5217	130P11	12945	NI ICP	N/A	Movable, Horizontal Array	19.3	mV/Pa	Pretest In-situ
245	Array Mic	PCB Mic #37	130M01	2714	130P11	12952	NI ICP	N/A	Movable, Horizontal Array	19.8	mV/Pa	Pretest In-situ
246	Array Mic	PCB Mic #38	130A10	5213	130P11	12964	NI ICP	N/A	Movable, Horizontal Array	25.1	mV/Pa	Pretest In-situ
247	Array Mic	PCB Mic #39	130B10	8821	130P11	8808	NI ICP	N/A	Movable, Horizontal Array	22.2	mV/Pa	Pretest In-situ
248	Array Mic	PCB Mic #40	130B10	8811	130P11	8607	NI ICP	N/A	Movable, Horizontal Array	21	mV/Pa	Pretest In-situ
249	Array Mic	PCB Mic #41	130B10	8842	130P11	9067	NI ICP	N/A	Movable, Horizontal Array	19.1	mV/Pa	Pretest In-situ
250	Array Mic	PCB Mic #42	130B10	8808	130P11	9055	NI ICP	N/A	Movable, Horizontal Array	19.4	mV/Pa	Pretest In-situ
251	Array Mic	PCB Mic #43	130A10	5202	130P11	5313	NI ICP	N/A	Movable, Horizontal Array	21.1	mV/Pa	Pretest In-situ
252	Array Mic	PCB Mic #44	130B10	8843	130P11	9072	NI ICP	N/A	Movable, Horizontal Array	20.1	mV/Pa	Pretest In-situ
253	Array Mic	PCB Mic #45	130B10	8831	130P11	9057	NI ICP	N/A	Movable, Horizontal Array	19.3	mV/Pa	Pretest In-situ
254	Array Mic	PCB Mic #46	130B10	8792	130P11	9056	NI ICP	N/A	Movable, Horizontal Array	22.3	mV/Pa	Pretest In-situ
255	Array Mic	PCB Mic #47	130B10	8801	130P11	8605	NI ICP	N/A	Movable, Horizontal Array	19.3	mV/Pa	Pretest In-situ
256	Array Mic	PCB Mic #48	130B10	8819	130P11	9048	NI ICP	N/A	Movable, Horizontal Array	20	mV/Pa	Pretest In-situ
257	Array Mic	PCB Mic #49	130B10	8817	130P11	9066	NI ICP	N/A	Movable, Horizontal Array	19.3	mV/Pa	Pretest In-situ
258	Array Mic	PCB Mic #50	130B10	8818	130P11	9049	NI ICP	N/A	Movable, Horizontal Array	21.6	mV/Pa	Pretest In-situ
259	Array Mic	PCB Mic #51	130B10	8803	130P11	9062	NI ICP	N/A	Movable, Horizontal Array	20.7	mV/Pa	Pretest In-situ
260	Array Mic	PCB Mic #52	130B10	8793	130P11	9058	NI ICP	N/A	Movable, Horizontal Array	24.9	mV/Pa	Pretest In-situ
261	Array Mic	PCB Mic #53	130B10	8825	130P11	9063	NI ICP	N/A	Movable, Horizontal Array	25.4	mV/Pa	Pretest In-situ
262	Array Mic	PCB Mic #54	130A10	2707	130P11	5295	NI ICP	N/A	Movable, Horizontal Array	22.1	mV/Pa	Pretest In-situ
263	Array Mic	PCB Mic #55	130B10	8809	130P11	9047	NI ICP	N/A	Movable, Horizontal Array	27.3	mV/Pa	Pretest In-situ
264	Array Mic	PCB Mic #56	130A10	2755	130P11	5317	NI ICP	N/A	Movable, Horizontal Array	23.7	mV/Pa	Pretest In-situ
265	Array Mic	PCB Mic #57	130M10	2718	130P11	5293	NI ICP	N/A	Movable, Horizontal Array	18.7	mV/Pa	Pretest In-situ
266	Array Mic	PCB Mic #58	130A10	2961	130P11	5294	NI ICP	N/A	Movable, Horizontal Array	20.3	mV/Pa	Pretest In-situ
267	Array Mic	PCB Mic #59	130A10	2924	130P11	5329	NI ICP	N/A	Movable, Horizontal Array	20.2	mV/Pa	Pretest In-situ
268	Array Mic	PCB Mic #60	130B10	8829	130P11	9059	NI ICP	N/A	Movable, Horizontal Array	21.7	mV/Pa	Pretest In-situ
269	Array Mic	PCB Mic #61	130B10	8834	130P11	9054	NI ICP	N/A	Movable, Horizontal Array	19.7	mV/Pa	Pretest In-situ
270	Array Mic	PCB Mic #62	130B10	8844	130P11	9073	NI ICP	N/A	Movable, Horizontal Array	22.4	mV/Pa	Pretest In-situ
271	Array Mic	PCB Mic #63	130B10	8815	130P11	9052	NI ICP	N/A	Movable, Horizontal Array	20.4	mV/Pa	Pretest In-situ
272	Array Mic	PCB Mic #64	130B10	8804	130P11	9060	NI ICP	N/A	Movable, Horizontal Array	27.4	mV/Pa	Pretest In-situ
273	Array Mic	PCB Mic #65	130B10	8837	130P11	9071	NI ICP	N/A	Movable, Horizontal Array	26.2	mV/Pa	Pretest In-situ
274	Array Mic	PCB Mic #66	130B10	8802	130P11	8602	NI ICP	N/A	Movable, Horizontal Array	22.9	mV/Pa	Pretest In-situ
275	Array Mic	PCB Mic #67	130B10	8794	130P11	8606	NI ICP	N/A	Movable, Horizontal Array	19.3	mV/Pa	Pretest In-situ
276	Array Mic	PCB Mic #68	130A10	2919	130P11	5321	NI ICP	N/A	Movable, Horizontal Array	24.8	mV/Pa	Pretest In-situ
277	Array Mic	PCB Mic #69	130A10	5085	130P11	5330	NI ICP	N/A	Movable, Horizontal Array	22.7	mV/Pa	Pretest In-situ
278	Array Mic	PCB Mic #70	130A10	2752	130P11	5277	NI ICP	N/A	Movable, Horizontal Array	19.4	mV/Pa	Pretest In-situ
279	Array Mic	PCB Mic #71	130A10	2963	130P11	5319	NI ICP	N/A	Movable, Horizontal Array	20.5	mV/Pa	Pretest In-situ
280	Array Mic	PCB Mic #72	130B10	8839	130P11	9070	NI ICP	N/A	Movable, Horizontal Array	22.6	mV/Pa	Pretest In-situ
281	Excitation	Impedance Head Force	PCB 288D01	1799	N/A	N/A	NI ICP	N/A	Shaker Drive Point	22.48	mV/N	Pretest In-situ
282	Excitation	Impedance Head Accel	PCB 288D01	1799	N/A	N/A	NI ICP	N/A	Shaker Drive Point	101.8	mV/g	Pretest In-situ
283	Mic	Intensity Probe 3, Part 1	Type 4197	2277817	Type 2682	2169201	Nexus	1	Back Bedroom, Window	11.76	mV/Pa	Pretest In-situ
284	Mic	Intensity Probe 3, Part 2	Type 4197	2277817	Type 2682	2169201	Nexus	2	Back Bedroom, Window	11.69	mV/Pa	Pretest In-situ
285	Mic	Intensity Probe 4, Part 1	Type 4197	2275991	Type 2682	2262123	Nexus	3	Back Bedroom, Wall	11.37	mV/Pa	Pretest In-situ
286	Mic	Intensity Probe 4, Part 2	Type 4197	2225991	Type 2682	2262123	Nexus	4	Back Bedroom, Wall	11.93	mV/Pa	Pretest In-situ
287	N/A	B&K Type 4193	Unknown	Unknown	B&K Type 2669	Unknown	Nexus	2	Outside Very Far Field	11	mV/Pa	See Table 3.4
288	N/A	Gras 40AE-S1	Unknown	Unknown	26CA	Unknown	NI ICP	N/A	Outside Northeast House Corner	48	mV/Pa	See Table 3.4

Table 3.3: Comparison of the factory calibration to in-situ calibration for the Endevco 2250A-10 accelerometers

Manufacture r	Model	Serial Number	Original Factory Sensitivity	In-situ Sensitivity	Percent Sensitivity Differe	Manufacture r	Model	Serial Number	Original Factory Sensitivity	In-situ Sensitivity	Percent Sensitivity Differe
Endevco	2250A-10	EC36*	9.97	10.10	1.30	Endevco	2250A-10	12901	10.11	10.11	0.00
Endevco	2250A-10	11075*	10.00	10.10	1.00	Endevco	2250A-10	12902	10.17	9.93	-2.36
Endevco	2250A-10	12862*	9.97	10.20	2.31	Endevco	2250A-10	12903	10.30	10.07	-2.23
Endevco	2250A-10	12865*	9.91	9.80	-1.08	Endevco	2250A-10	12904	10.03	10.07	0.40
Endevco	2250A-10	12870*	9.81	9.90	0.92	Endevco	2250A-10	12905	10.00	9.96	-0.40
Endevco	2250A-10	12873*	10.02	10.00	-0.20	Endevco	2250A-10	12910	9.85	9.90	0.51
Endevco	2250A-10	12877*	9.99	9.92	-0.66	Endevco	2250A-10	12912	10.15	10.33	1.77
Endevco	2250A-10	12891*	10.20	10.09	-1.08	Endevco	2250A-10	12913	10.08	10.23	1.49
Endevco	2250A-10	12920*	10.14	10.33	1.87	Endevco	2250A-10	12914	10.15	10.11	-0.39
Endevco	2250A-10	12921*	10.01	10.00	-0.10	Endevco	2250A-10	12915	9.98	10.00	0.20
Endevco	2250A-10	12922*	10.03	10.04	0.10	Endevco	2250A-10	12916	9.98	9.99	0.10
Endevco	2250A-10	12926*	10.08	10.26	1.79	Endevco	2250A-10	12919	9.99	10.00	0.10
Endevco	2250A-10	12927*	10.09	10.32	2.28	Endevco	2250A-10	12928	9.94	10.16	2.21
Endevco	2250A-10	12937*	10.03	10.04	0.10	Endevco	2250A-10	12931	10.17	10.11	-0.59
Endevco	2250A-10	12939*	10.02	10.01	-0.10	Endevco	2250A-10	12932	9.84	10.00	1.63
Endevco	2250A-10	12942*	10.15	10.27	1.18	Endevco	2250A-10	12934	10.15	10.16	0.10
Endevco	2250A-10	12943*	10.09	10.11	0.20	Endevco	2250A-10	12935	10.03	10.12	0.90
Endevco	2250A-10	12946*	10.14	10.17	0.30	Endevco	2250A-10	12941	9.94	9.96	0.20
Endevco	2250A-10	12954*	10.13	10.17	0.39	Endevco	2250A-10	12945	9.83	10.08	2.54
Endevco	2250A-10	12956*	10.03	10.12	0.90	Endevco	2250A-10	12992	10.00	10.09	0.90
Endevco	2250A-10	12957*	10.14	10.16	0.20	Endevco	2250A-10	13093	10.04	10.16	1.20
Endevco	2250A-10	13094*	10.14	10.09	-0.49	Endevco	2250A-10	13449	10.47	10.22	-2.39
Endevco	2250A-10	13098*	10.06	10.09	0.30	Endevco	2250A-10	13807	10.11	10.15	0.40
Endevco	2250A-10	13102*	10.02	10.17	1.50	Endevco	2250A-10	13847	10.22	10.20	-0.20
Endevco	2250A-10	13109*	10.28	10.11	-1.65	Endevco	2250A-10	14121	10.16	10.13	-0.30
Endevco	2250A-10	13113*	9.94	10.03	0.86	Endevco	2250A-10	14142	10.15	10.14	-0.10
Endevco	2250A-10	13115*	10.14	10.47	3.25	Endevco	2250A-10	14143	10.36	9.96	-3.86
Endevco	2250A-10	13133*	10.09	10.05	-0.40	Endevco	2250A-10	14160	10.13	10.15	0.20
Endevco	2250A-10	13821*	9.96	10.05	0.88	Endevco	2250A-10	14182	10.07	10.10	0.30
Endevco	2250A-10	13848*	10.06	10.08	0.20	Endevco	2250A-10	14183	10.15	10.09	-0.59
Endevco	2250A-10	13857*	10.03	10.16	1.30	Endevco	2250A-10	14189	10.07	9.98	-0.89
Endevco	2250A-10	13858*	10.02	10.06	0.40	Endevco	2250A-10	14190	10.00	10.02	0.20
Endevco	2250A-10	13860*	9.94	10.04	0.97	Endevco	2250A-10	14206	10.20	10.18	-0.20
Endevco	2250A-10	13862*	10.01	10.14	1.30	Endevco	2250A-10	11136	10.08	10.22	1.39
Endevco	2250A-10	13875*	10.03	10.06	0.30	Endevco	2250A-10	11061	10.02	10.03	0.10
Endevco	2250A-10	12858	9.97	10.07	1.00	Endevco	2250A-10	11079	10.01	10.19	1.80
Endevco	2250A-10	12859	10.08	10.00	-0.79	Endevco	2250A-10	11083	9.94	9.94	0.00
Endevco	2250A-10	12878	9.93	10.09	1.61	Endevco	2250A-10	11096	9.99	9.97	-0.20
Endevco	2250A-10	12879	10.13	9.97	-1.58	Endevco	2250A-10	11101	10.03	10.00	-0.30
Endevco	2250A-10	12899	10.27	10.41	1.36	Endevco	2250A-10	11111	10.25	10.42	1.66
Endevco	2250A-10	12900	10.05	10.08	0.30	Endevco	2250A-10	11121	10.11	10.21	0.99

* denotes accelerometers that were sent to Simco for calibration prior to the test

Table 3.4: Daily Sensitivities of the Precision Microphones Found From In-situ Field Calibrations

Mic Channel	Channel													
	Precal 6/13	Postcal 6/13	6/14	Precal 6/15	Precal 6/16	Postcal 6/16	Precal 6/20	Postcal 6/20	Precal 6/21	Postcal 6/21	Precal 6/22	Postcal 6/22	Gains During Calibration	Mic Type
	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	mV/Pa	
1	48.1	48.8	48.7	48.2	49.1	48.7	49.1	47.9	48.3	48.9	49.3	48.2	1	Gras 40AQ
2	50.3	49.9	50.5	49.8	50.3	49.9	50.3	50	49.3	50.2	49.6	49.1	1	Gras 40AQ
3	50.0	49.2	50	49.1	49.5	49.5	49.3	48.9	48.4	49.8	48.6	48.1	1	Gras 40AQ
61	49.1	48.1	48.8	48.4	48.9	48.8	48.3	48.1	48.2	48.8	48.9	48.2	1	Gras 40AQ
62	47.5	46.8	46.8	47.6	47.5	47.7	47.7	46.9	47.3	47.7	47	47.2	1	Gras 40AQ
129	NAN	NAN	NAN	NAN	99.1	99.0	NAN	NAN	99.1	NAN	NAN	NAN	1	Norm Left Ear
136	NAN	NAN	NAN	NAN	99.3	99.1	NAN	NAN	99.3	NAN	NAN	NAN	1	Norm Right Ear
177	51.3	50.7	51.4	50.8	50.5	45.3*	51.1	49.9	51.5	51.5	NAN	51.3	1	Gras 40AQ
178	45.9	45.3	45.9	45.3	45.3	50.9*	45.4	44.3	45.9	45.5	NAN	NAN	1	Gras 40AQ
179	53.0	50.6	52	52.3	52.5	52.5	58.8	54.2	55.4	56.6	53	61.6	1	Gras 40AE-S1
180	47.9	49.1	48.1	48.5	49.7	47.3	48.5	49	48.5	48.7	48.7	48.5	1	Gras 40AQ
181	52.4	52.3	52	51.6	52.6	51.1	52.5	52.2	51.2	51.9	51.1	52	1	Gras 40AE
182	44.1	44.1	45.1	45	44.7	43.4	45.2	44.2	44.2	44.7	43.2	44	1	Gras 40AQ
183	43.2	45.6	43.5	43.8	43.5	45	43.3	41.8	43.3	46.3	42.6	45.9	1	Gras 40AE-S1
184	42.0	42.5	42.1	42.2	42	44.8	42.4	41	41.9	49.1	41.4	41.6	1	Gras 40AE-S1
185	49.9	49.6	49.8	49.6	49.6	49.5	49.5	49	49.3	51	48.6	49	1	Gras 40AQ
186	52.3	51.9	51.1	51.6	51.9	51	51.8	50.8	52.2	51.1	50.7	51.2	1	Gras 40AE
187	45.1	44.9	44.8	44.8	45.1	44.6	45.7	45.2	45.2	45.4	45.2	45.3	1	Gras 40AE
188	49.0	47.2	48.5	48.5	49.3	48.2	49.4	49.2	49.5	48.3	51	49.8	1	Gras 40AQ
189	46.3	46.2	46.6	46.8	46.8	45.5	46.5	46.6	46.8	45.8	48.3	47	1	Gras 40AQ
190	44.7	47.8	46.9	45.5	47.8	51.6	43.4	52.2	44.2	54.4	58.5	58	1	Gras 40AE-S1
191	45.3	45.8	46.6	45.9	48.6	47.1	46.9	48	49.5	53.9	44.7	45.3	1	Gras 40AE-S1
192	47.4	46.7	47.6	46.2	47.1	46.3	47.1	46.7	46	46.3	45.9	46.4	1	Gras 40AE
193	48.3	47.5	47.2	46.7	52.1	49.8	52.6	51.8	52.3	49.8	48.7	51.7	1	Gras 40AE-S1
194	41.6	41.5	41.9	42.1	41.5	41.4	41.4	41.6	41.6	41.8	41.8	41	3.16	B&K Type 4193
195	42.8	43	43.2	42.9	43	43.1	43.3	43.7	43	43.7	42.9	43.2	3.16	B&K Type 4193
196	36.9	36.2	37.4	36.7	37.7	36	36.8	36.2	36.6	35.9	36.5	36.8	3.16	B&K Type 4193
197	41.7	41.8	42.1	42	42.8	42	42.7	42	42.7	41.9	42.9	42.4	3.16	B&K Type 4193
198	40.7	40.8	40.8	40.7	40.9	40.8	40.7	40.2	40.8	41.2	40	40	3.16	B&K Type 4193
199	40.1	40.5	40.2	40.3	40.3	41.4	40.4	40.9	40.5	41.2	39.4	39.7	3.16	B&K Type 4193
200	44.5	44.5	44	44.5	43.8	44.2	44.5	44.6	44.2	45.1	44.7	45	3.16	B&K Type 4193
201	41.5	41.4	41.6	41.7	41.7	41.3	41.5	41.9	41.5	41.5	41.7	42.7	3.16	B&K Type 4193
202	41.6	41.5	41.6	41.5	41.6	41.1	41.5	41.7	41.3	41.7	42.2	43.5	3.16	B&K Type 4193
203	43.5	42.8	43.3	43	43.2	42.8	43.2	42.6	43	43.1	43.4	43.6	3.16	B&K Type 4193
204	40.8	40.3	40.8	40.3	40.5	40.4	40.3	39.7	40.7	41	41.8	42.2	3.16	B&K Type 4193
205	41.3	40.7	41.1	40.6	40.6	40.4	41	40.6	40.2	40.9	40.4	NAN	3.16	B&K Type 4193
206	41.7	41.7	42.3	41.7	41.7	42	42	41.6	41.6	42.5	41.7	41.4	3.16	B&K Type 4193
207	41.1	41.1	42.3	42	42.1	40.9	41.7	41.2	42.3	41.1	NAN	41.8#	3.16	B&K Type 4193
287	NAN	NAN	NAN	NAN	NAN	NAN	NAN	36.7	36.4	36.5	NAN	NAN	3.16	B&K Type 4193
288	NAN	NAN	NAN	48.1	48.2	47.4	49.2	47.4	49.3	47.3	NAN	NAN	1	Gras 40AE

NAN indicates that the channel was not present on that measurement day.

* indicates two channels that were switched after pre-cal but before that days measurements.

indicates the swap of microphone originally on channel 206 to the measurement channel and cable 207.

Note: even though measurements were not made on 6/14, calcs were done on that day and are included above.

Table 3.5: Changes made to the transducers throughout the experiment.

Date	Measurement Session Start Time	Location of Accelerometer on Channel 112	Location of the Vertical Microphone Array ¹	Location of the Horizontal Microphone Array ¹	Sphere in Front of Window ¹	Exterior Microphone Layout
6/13/2006	9:23:20 AM	Back Bedroom Floor	Vertical Array Position A	Horizontal Array Position A	No	Nominal ²
	11:00:14 AM	Back Bedroom Floor	Vertical Array Position A	Horizontal Array Position A	No	Nominal ²
6/15/2006	10:58:34 AM	Collocated with Accelerometer 122 *	Vertical Array Position A	Horizontal Array Position B	No	Nominal ²
		Collocated with Accelerometer 122 *	Vertical Array Position A	Horizontal Array Position B	No	Nominal ²
6/16/2006	9:29:18 AM	Collocated with Accelerometer 122 *	Vertical Array Position A	Horizontal Array Position B	No	Nominal ²
	11:03:41 AM	Collocated with Accelerometer 122 *	Vertical Array Position A	Horizontal Array Position B	No	Nominal ²
6/20/2006	9:52:28 AM	Collocated with Accelerometer 122 *	Vertical Array Position A	Horizontal Array Position B	No	Nominal ²
	11:11:31 AM	Collocated with Accelerometer 122 *	Vertical Array Position A	Horizontal Array Position B	No	Nominal ²
6/21/2006	9:26:11 AM	Collocated with Accelerometer 122 *	Vertical Array Position B	Horizontal Array Position C	No	Nominal ²
	10:56:31 AM	Collocated with Accelerometer 122 *	Not Measured	Horizontal Array Position C ⁴	Yes ⁵	Nominal ²
6/22/2006	9:25:30 AM	Collocated with Accelerometer 122 *	Not Measured	Moved Outside to Street	No	Altered ³

* The accelerometer on channel 112 was mounted in the location of accelerometer 122 and the accelerometer on 122 was mounted to the back of accelerometer 112.

¹ See Appendix G.

² See Appendix F.

³ See Appendix F and H.

⁴ Only channels 259 through 280 were measured during this measurement session.

⁵ The sphere was connected to channels 209 through 258.

Table 3.6: Changes in the bedrooms throughout the experiment.

Date	Measurement Session Start Time	Back Bedroom Window	Front Bedroom Mirrors	Back Bedroom Foam Pads	Front Bedroom Foam Pads	Front Bedroom Window	Toilets
6/13/2006	9:23:20 AM	Closed	On Wall	Nominal	Nominal	Shimmed with Paper Towel*	
	11:00:14 AM	Closed	On Wall	Nominal	Nominal	Shimmed with Paper Towel*	
6/15/2006	10:58:34 AM	Closed	On Wall	Nominal	Nominal	Shimmed with Paper Towel*	
6/16/2006	9:29:18 AM	Open 10 Inches	On Wall	Nominal	Nominal	Shimmed with Paper Towel*	
	11:03:41 AM	Closed	On Wall	Nominal	Nominal	Shimmed with Paper Towel*	
	9:52:28 AM	Closed	On Wall	Nominal	Nominal	Shimmed with Paper Towel*	
6/20/2006	11:11:31 AM	Closed	On Wall	Heavy Damping ¹	Light Damping ²	Shimmed with Paper Towel*	Hall Toilet Intermittently Running
6/21/2006	9:26:11 AM	Open 12 Inches	Off	Heavy Damping ¹	Light Damping ²	Shimmed with Paper Towel*	
	10:56:31 AM	Closed	Off	Nominal	Nominal	Removed Shims	
6/22/2006	9:25:30 AM	Closed	Off	Nominal	Nominal	Removed Shims	

* Small paper towel shims were forced in between the window frame and track to reduce the rattle of the window in the front bedroom. The back bedroom was not shimmed.

¹ See Figure 3.6. Four foam pads were removed from the front bedroom and placed in the back bedroom to increase the absorption in the back bedroom.

² See Figure 3.6. Four foam pads were removed from the front bedroom to decrease the absorption.

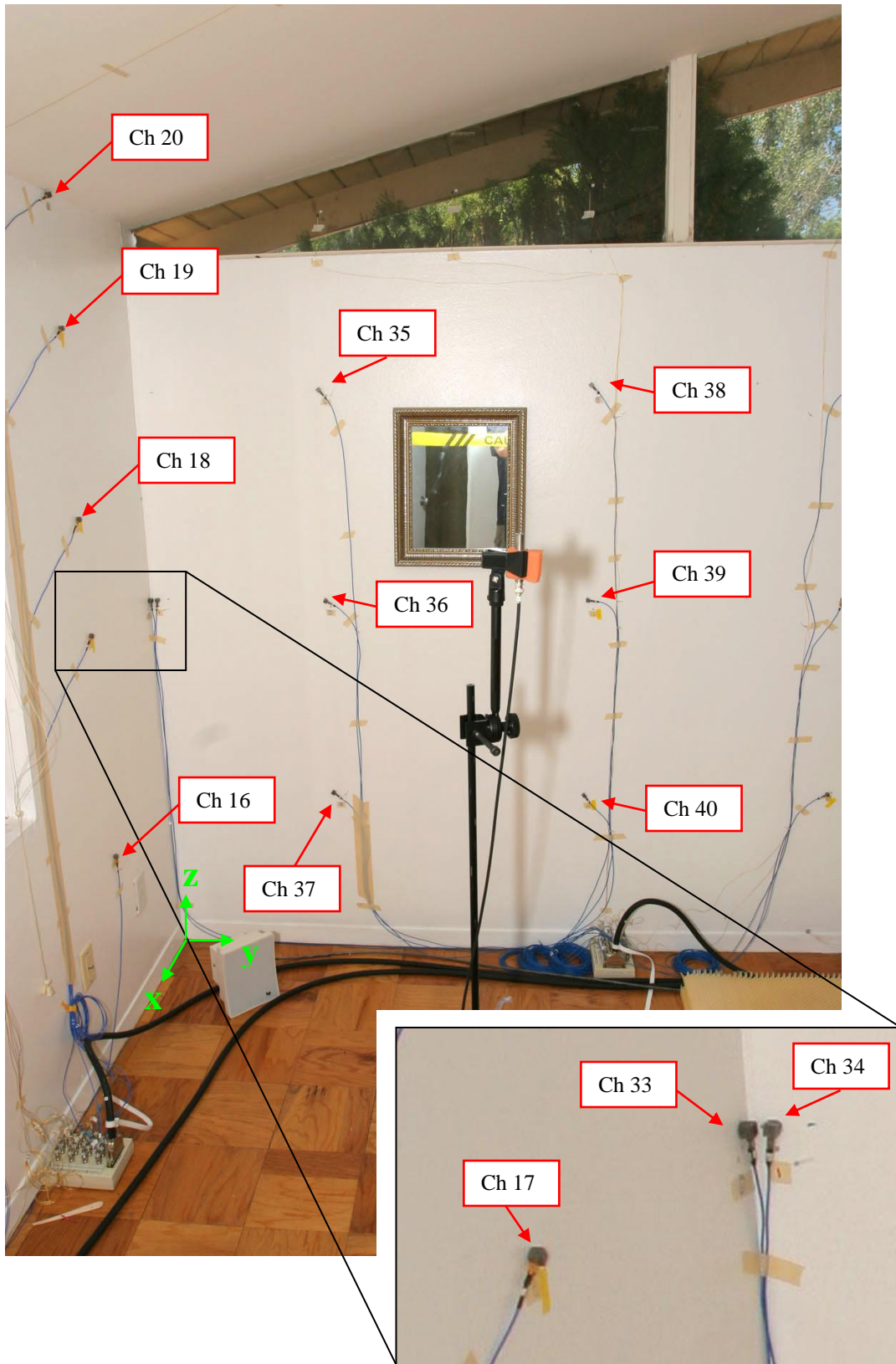


Figure 3.1: Typical picture of accelerometers mounted to the wall in the front bedroom. Detail shows co-located accelerometers mounted to the west and north walls.

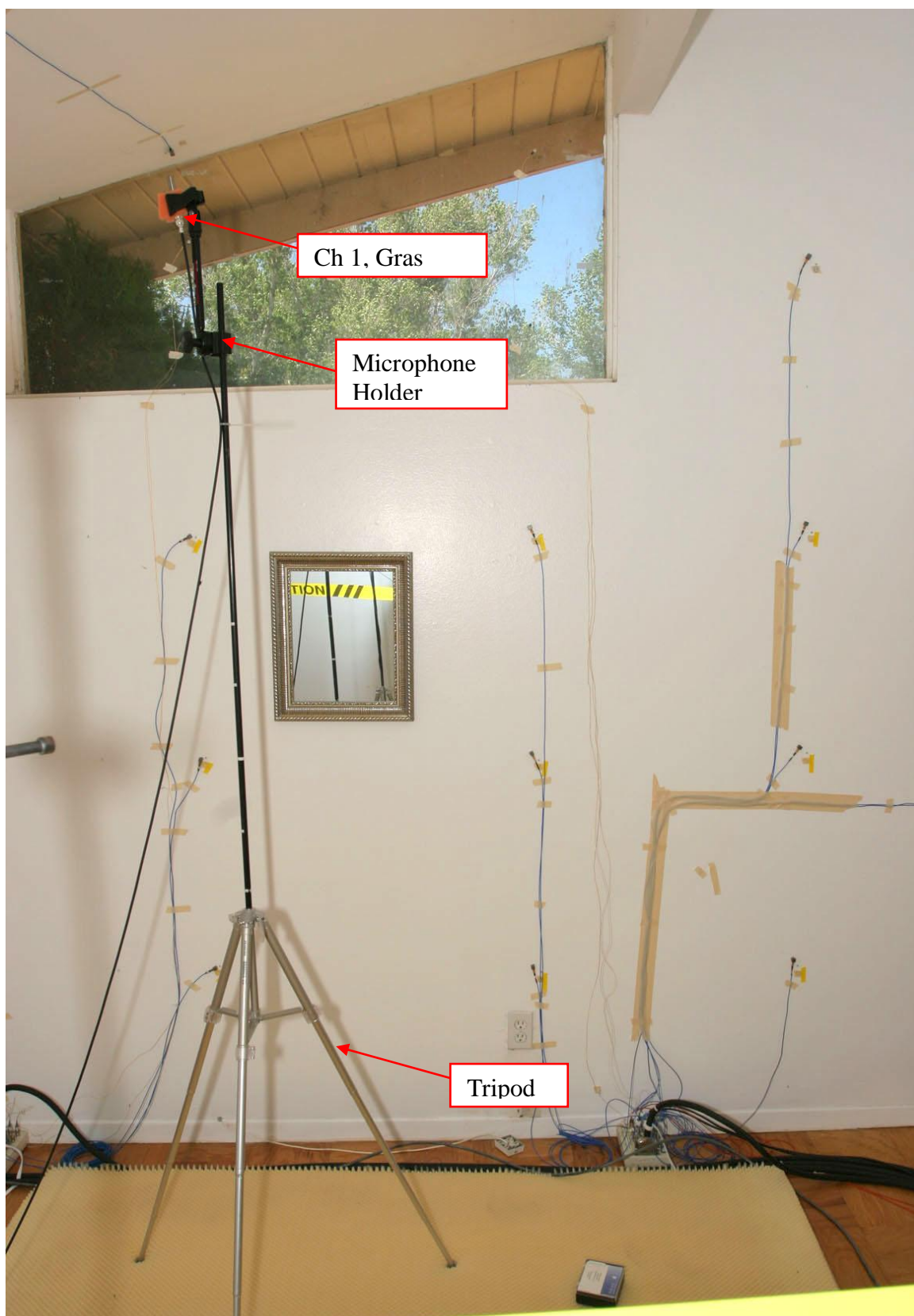


Figure 3.2: Picture of an indoor microphone mounted to a tripod.

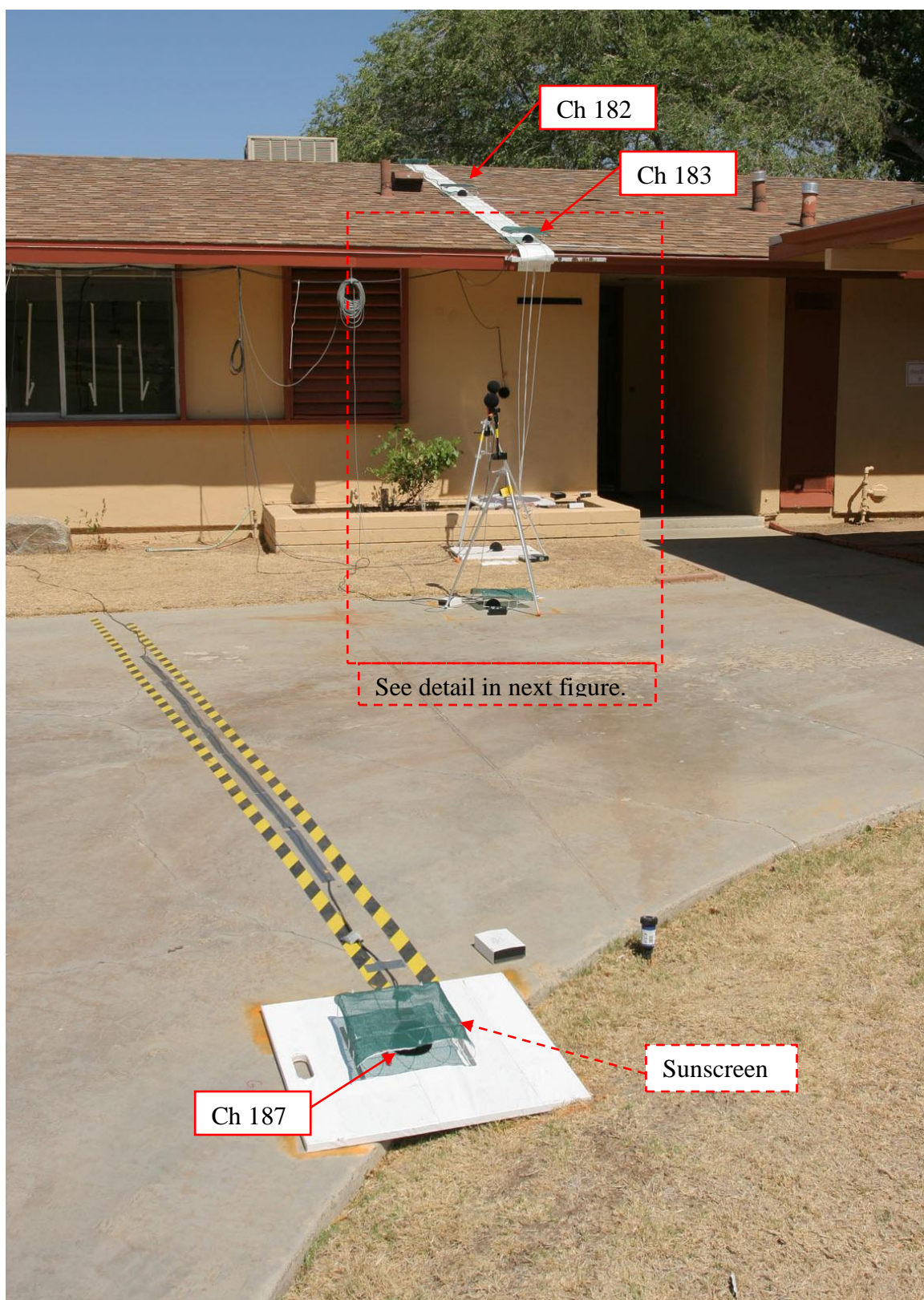


Figure 3.3: The seven microphones in the front yard and the microphones on the roof.

Figure 3.4: Six of the seven microphones in the front yard (channel 187 not shown).

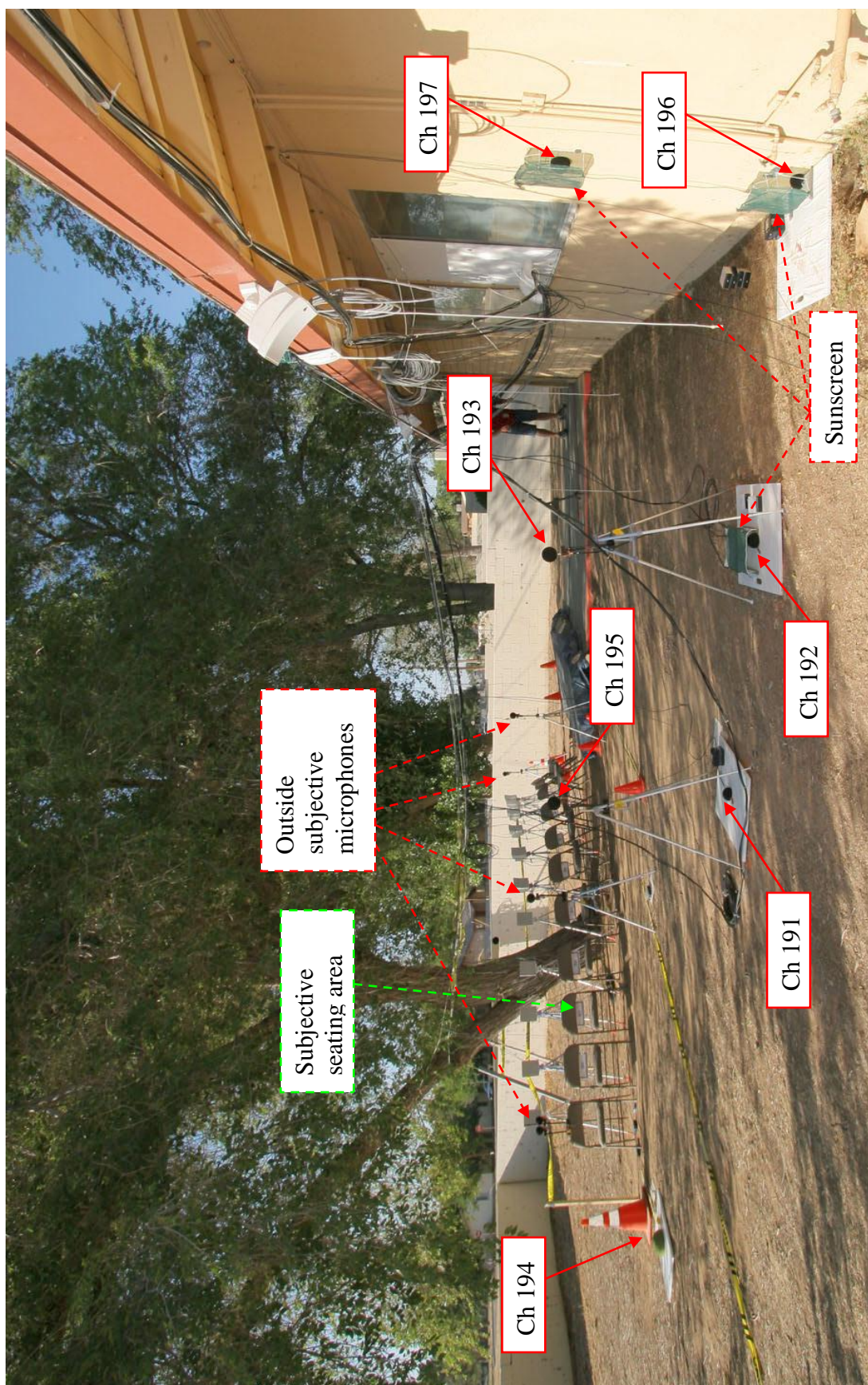


Figure 3.5: The seven microphones in the back yard and the outdoor subjective seating area.

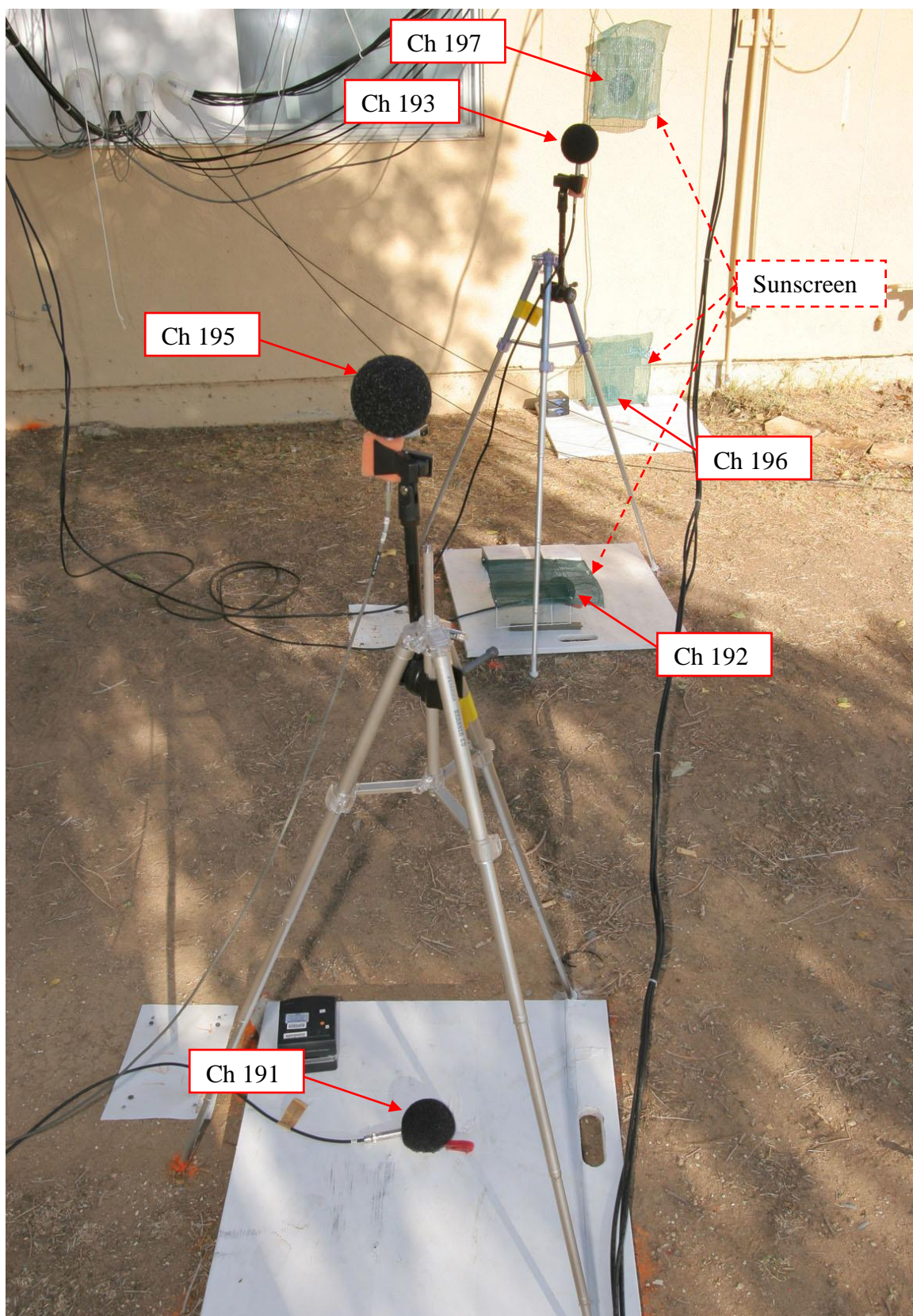


Figure 3.6: Six of the seven microphones in the back yard (channel 194 not shown).



Figure 3.7: Picture of the five roof microphones. Screens are visible over each microphone.

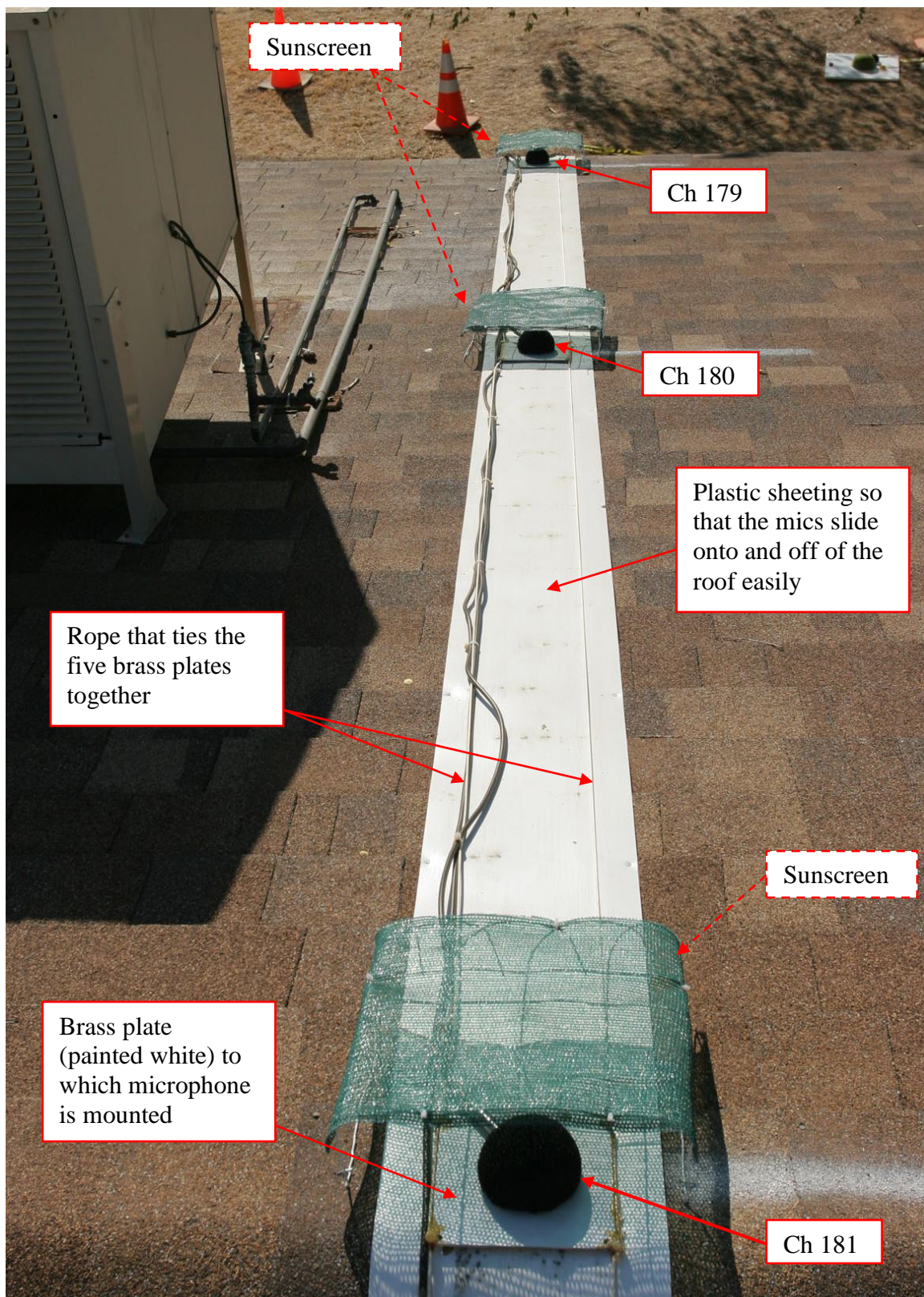


Figure 3.8: Close-up of the roof microphones.

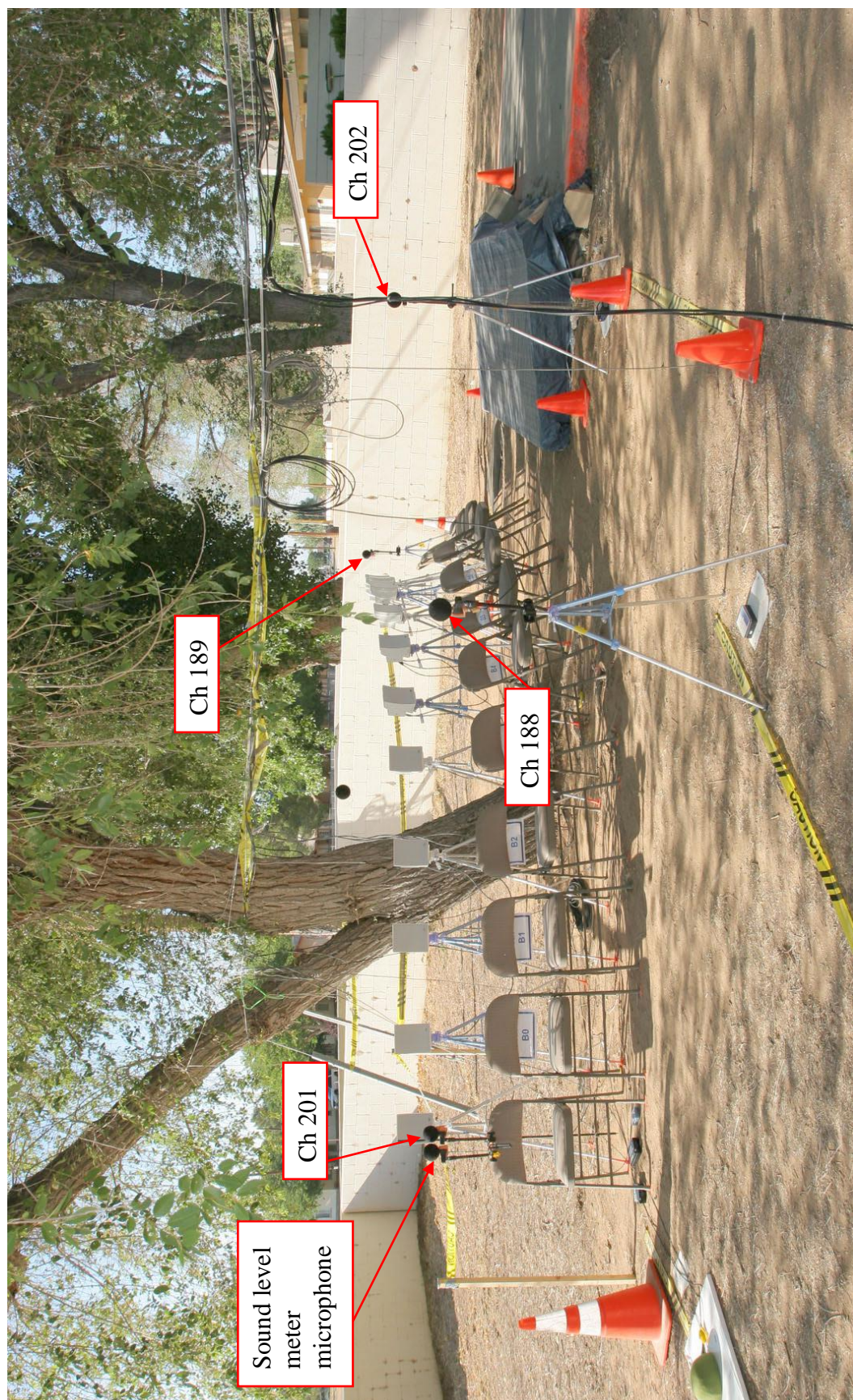


Figure 3.9: Photograph of the outdoor subjective seating area and the four subjective microphones.

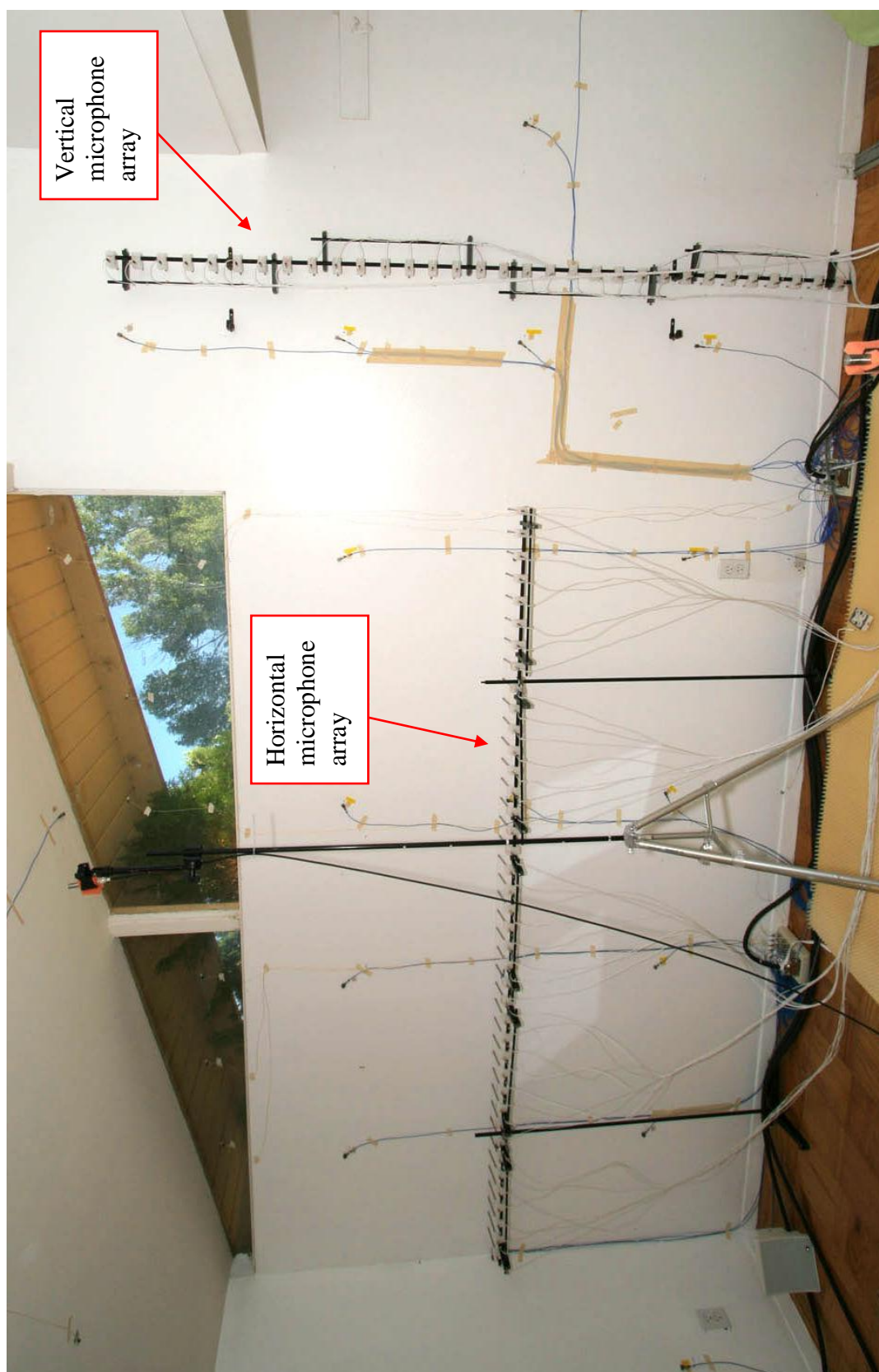


Figure 3.10: Photograph of the horizontal and vertical arrays placed on the north wall of the front bedroom.

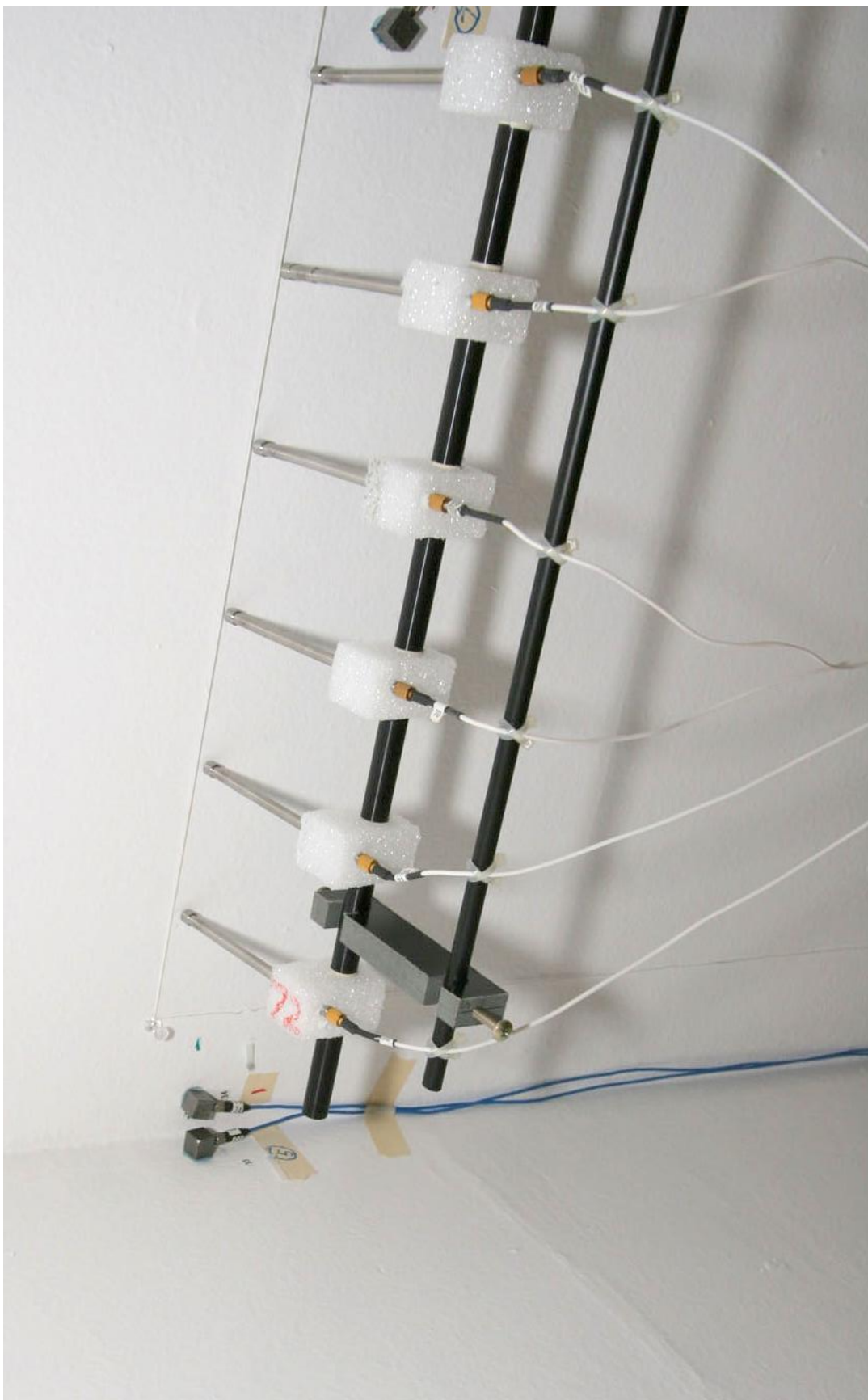


Figure 3.11: Close up of the PCB 130-series microphones in the horizontal microphone array.

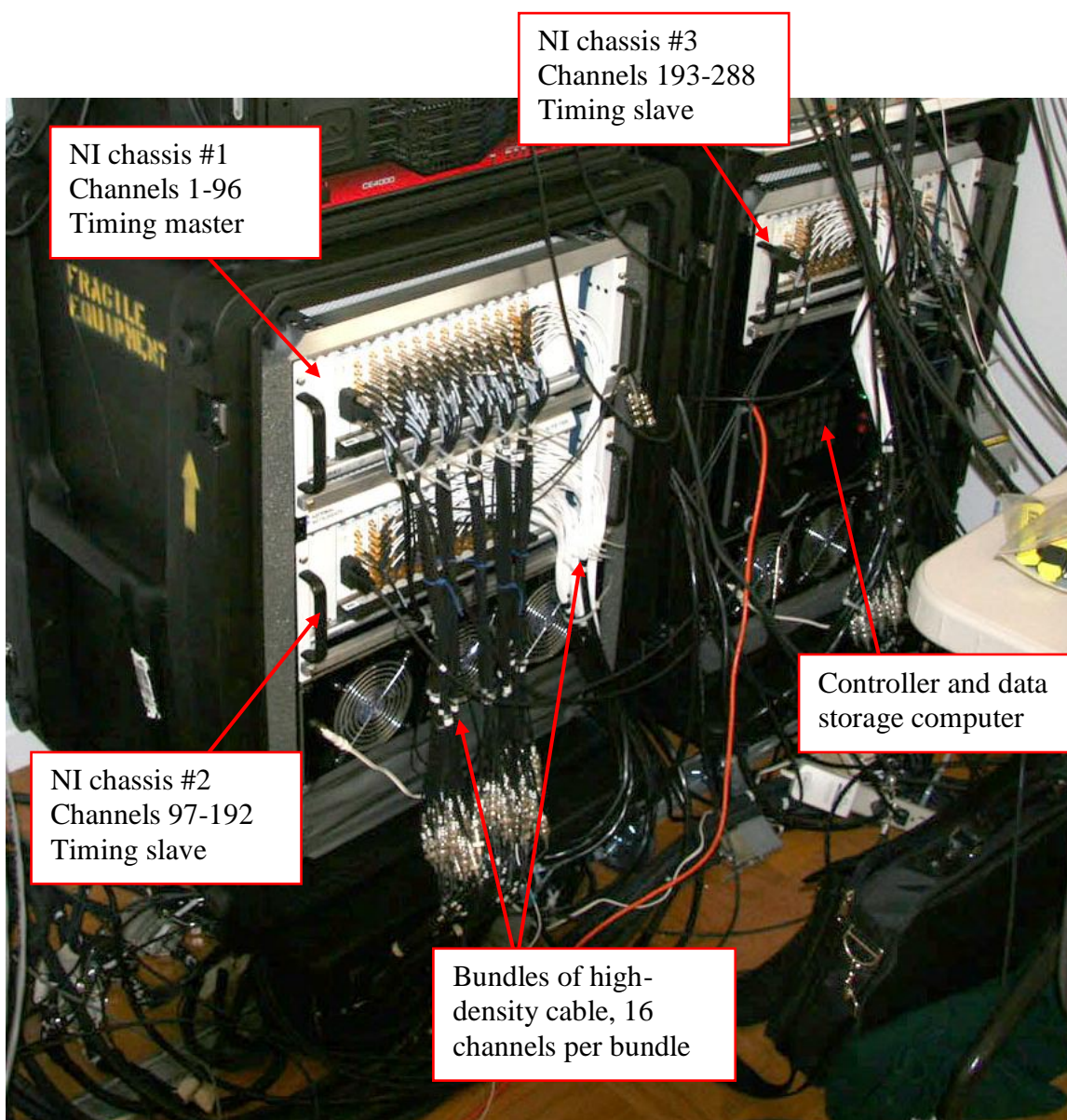


Figure 3.12: Data acquisition hardware.

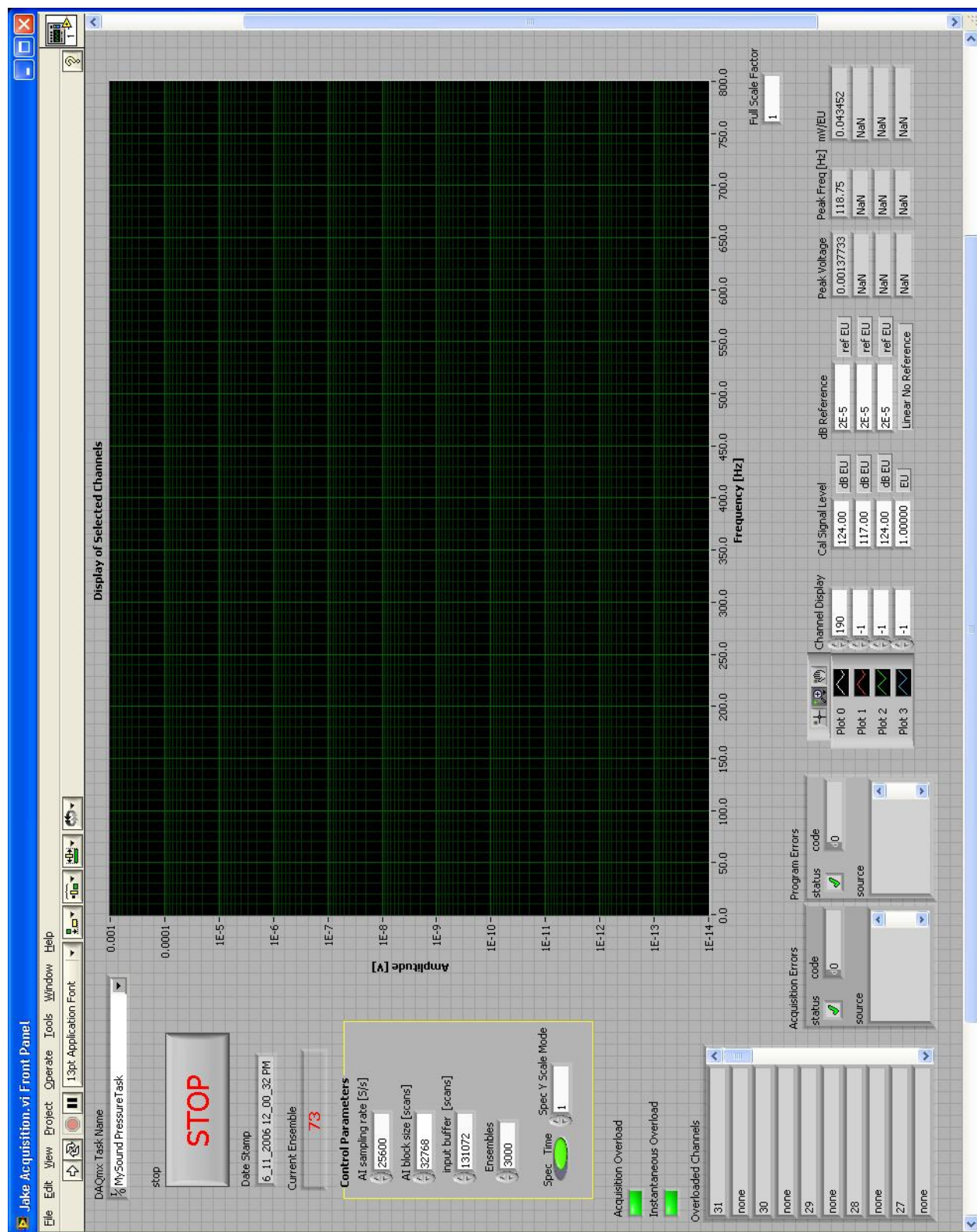
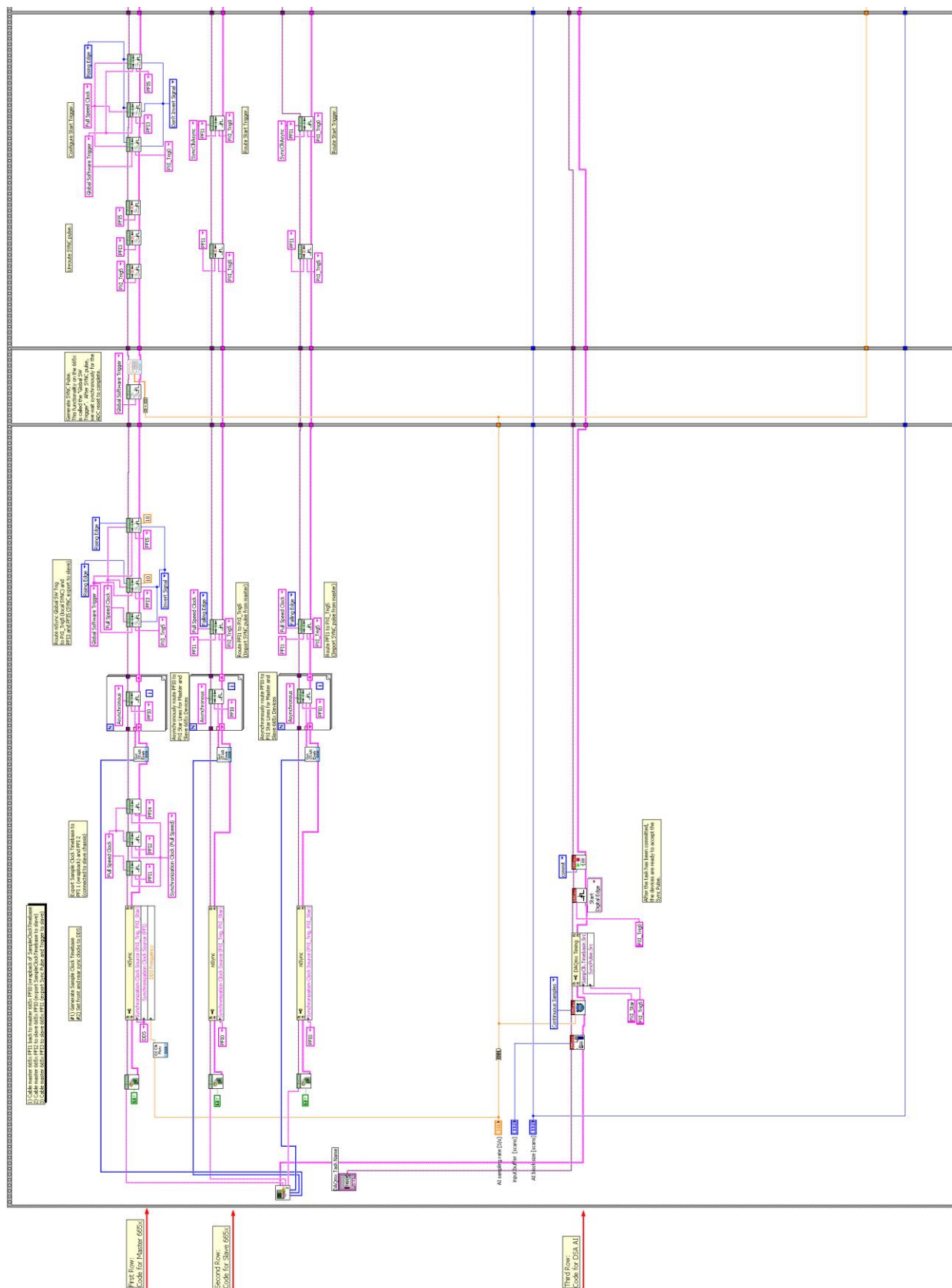


Figure 3.13: Data acquisition software front panel.



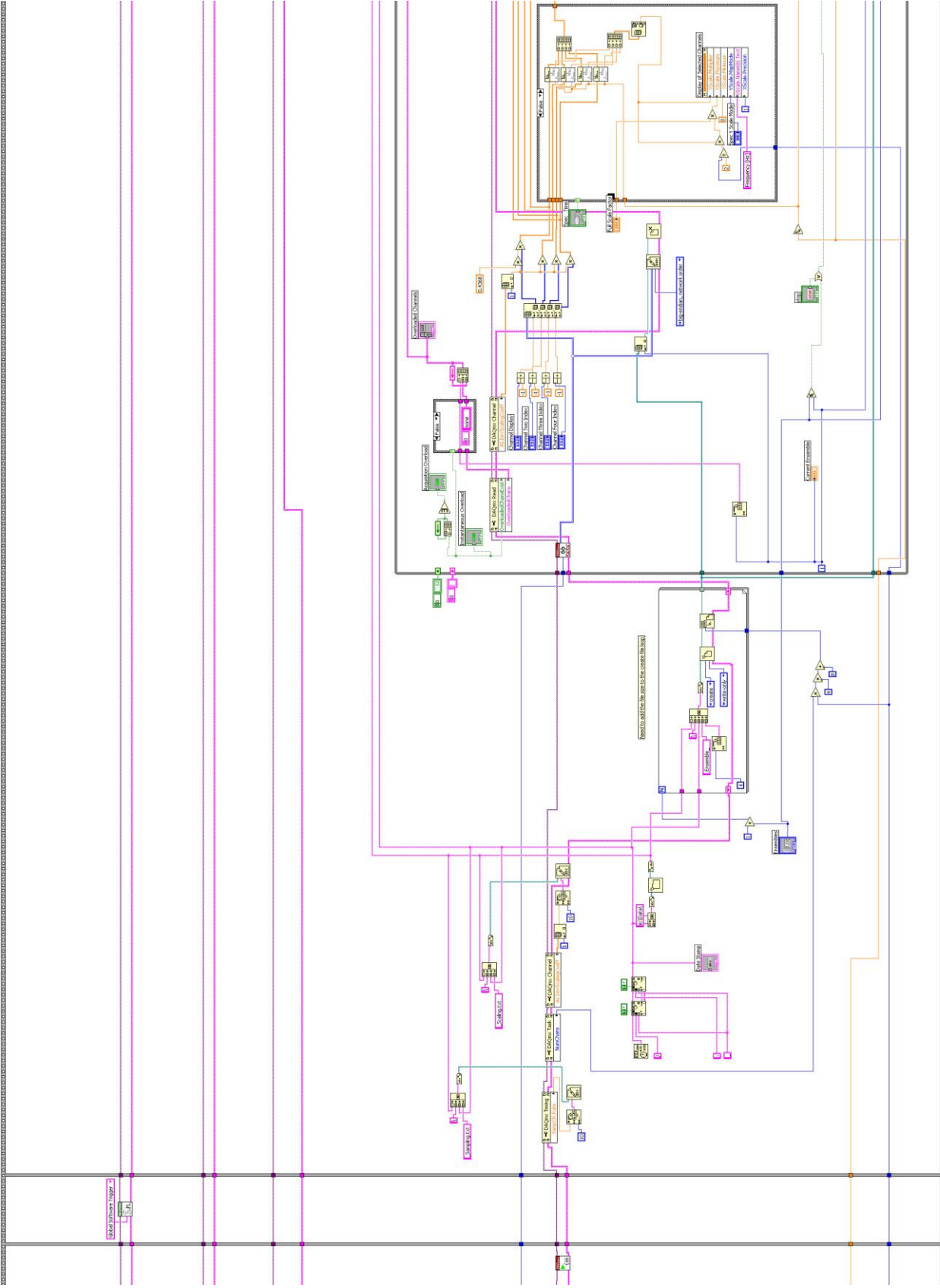


Figure 3.14: Data acquisition software schematic (continued on next page).

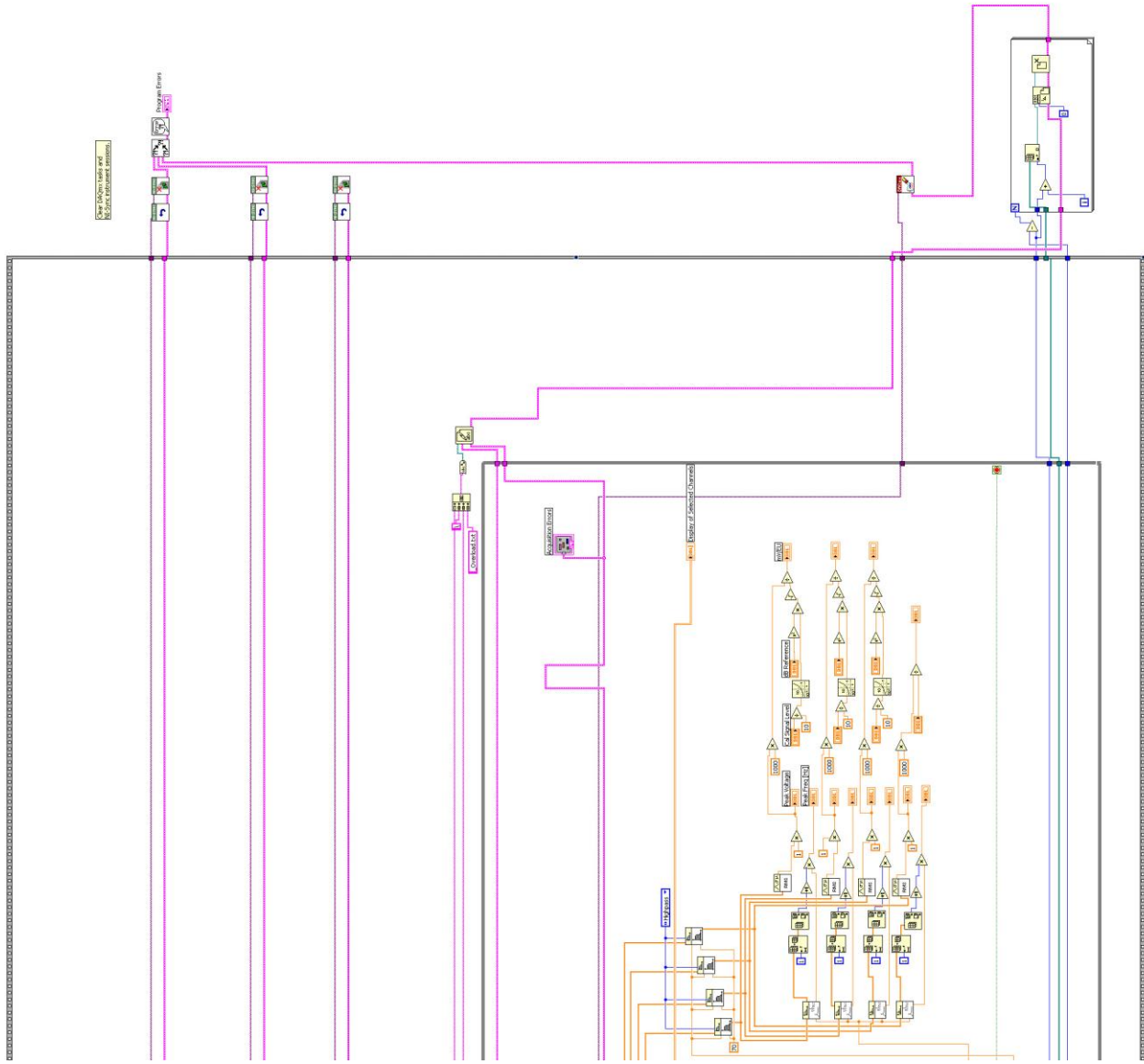


Figure 3.14: Data acquisition software schematic (concluded).

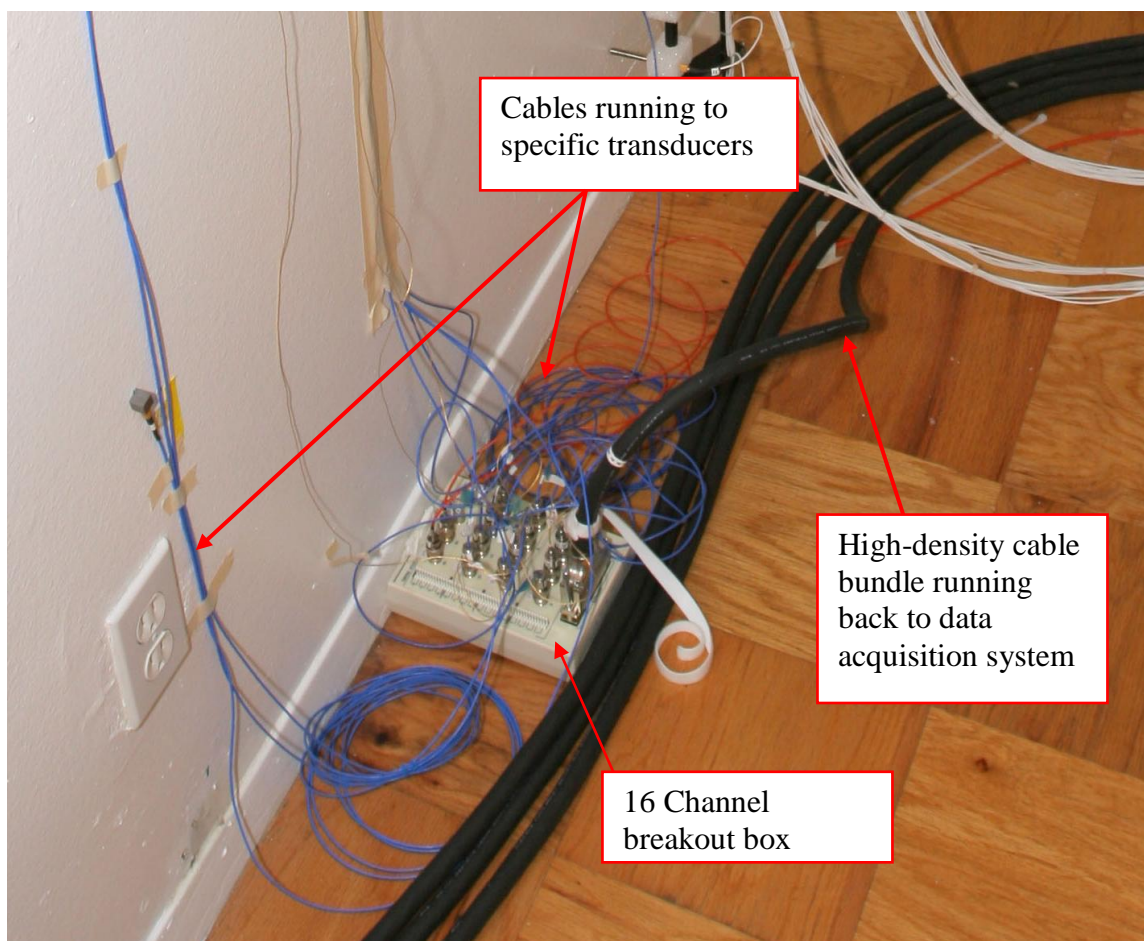


Figure 3.15: A 16 channel breakout box used with the high density cables.



Figure 3.16: Photographs of the mirrors that were hung on the north wall of the front bedroom for some of the tests, a) with the mirrors hanging and b) without the mirrors.



Figure 3.17: Picture of the window open in the east wall of the back bedroom. Intensity probes are placed in front of both the open and closed portions of the window.

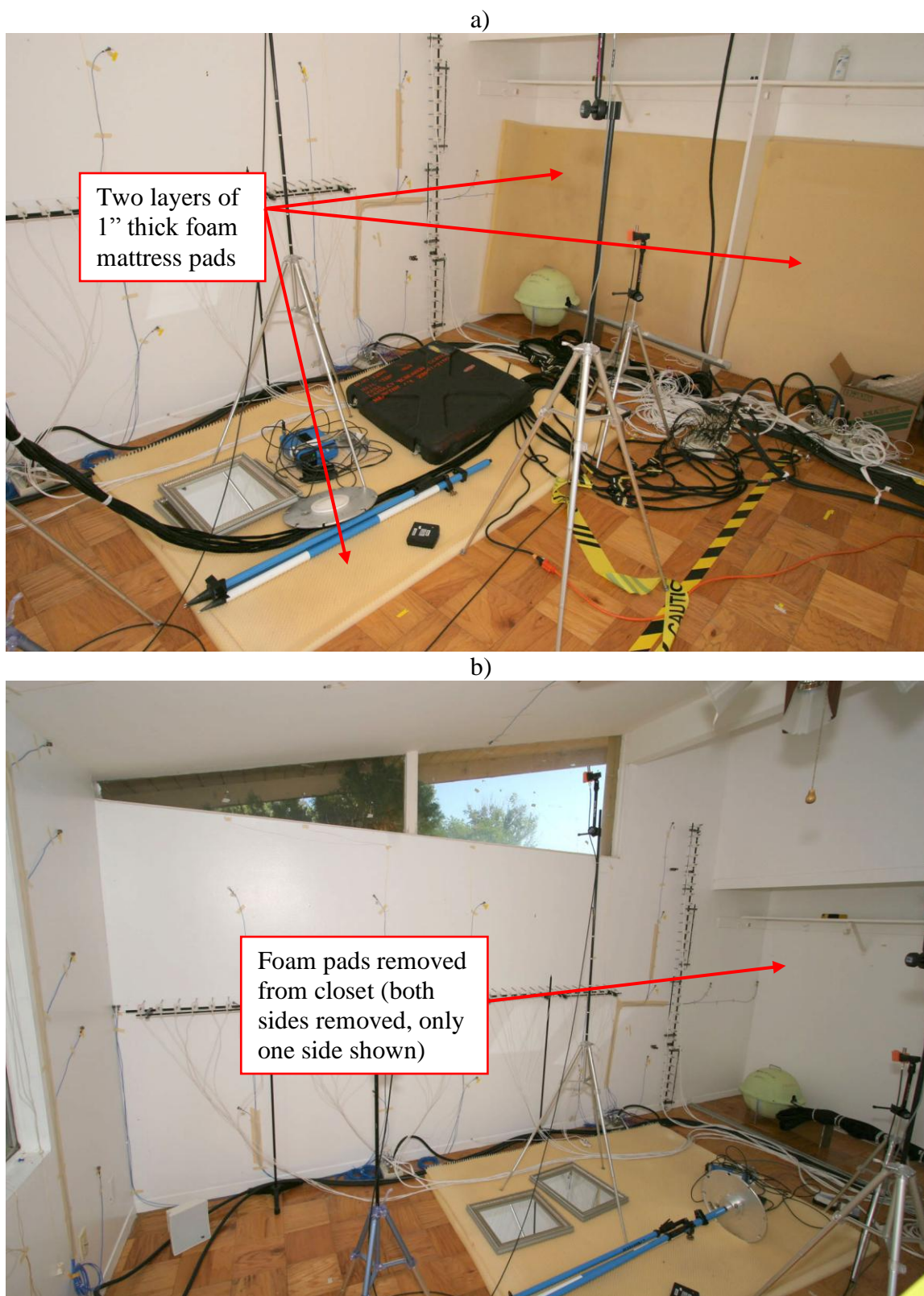


Figure 3.18: Photographs of the foam padding in the front bedroom, a) nominal layout and b) lightly damped configuration used on 6/20/06 and 6/21/06.

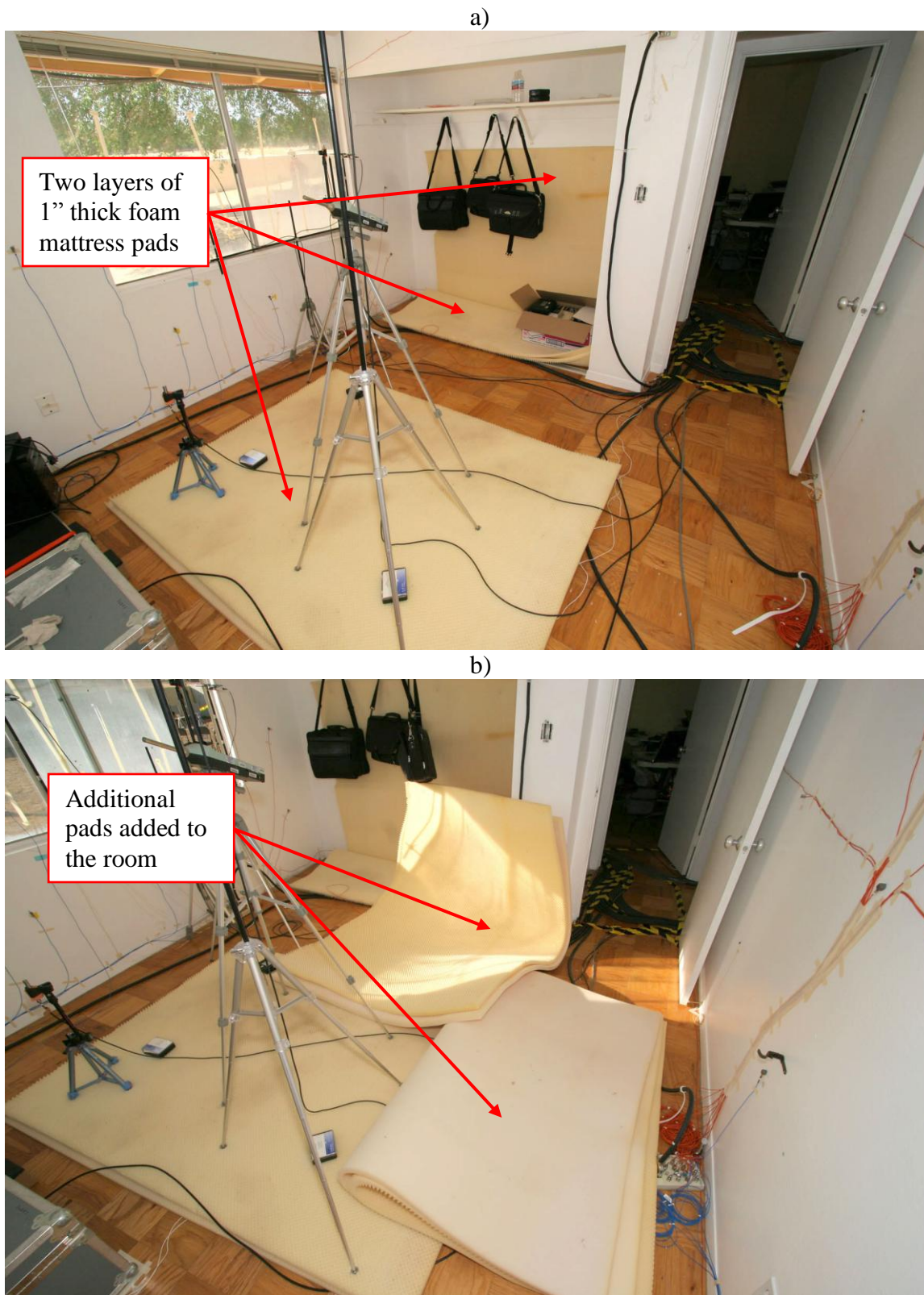


Figure 3.19: Photographs of the foam padding in the back bedroom, a) nominal layout and b) heavily damped configuration used on 6/20/06 and 6/21/06.

CHAPTER 4: DESCRIPTION OF THE FLIGHTS

Nineteen flights of NASA Dryden-operated F/A-18B aircraft were flown during six test days on the 13th, 15th, 16th, 20th, 21st, and 22nd of June 2006. During each flight, the aircraft typically produced six sonic booms that were recorded at the house. On each day, several flights were flown, and two aircraft were flown simultaneously as documented in Table 4.1. During each measurement session, these simultaneous flights (Table 4.1) were used to reduce the time gap in-between booms arriving at the house. This reduction was necessitated by requirements of the subjective portion of the experiment that was occurring in parallel with the structural measurements documented in this report. The flight plan for a single aircraft dictated that it would only be capable of producing one boom at the house every six minutes. A six-minute gap was deemed too long by the subjective investigators. Thus, with two aircraft in the air at the same time and appropriate spacing, the nominal gap between boom arrivals was reduced to approximately three minutes.

In total, 98 low amplitude and 14 normal amplitude booms were recorded at the house. The number of booms per flight is summarized in Table 4.1. Flights 1 through 17 on June 13th through the 21st (Table 4.1) produced six low amplitude sonic booms each, except for flight 7 on June 16th during which the aircraft had problems with the avionics system and was only able to produce two booms. On these days, low amplitude booms were generated by a unique dive maneuver described in Section 4.1. The peak overpressure of these low amplitude booms, as measured by the ground microphone on channel 194 in the backyard, ranged from 0.05 lb_f/ft² to 0.8 lb_f/ft² (see Chapter 6). On June 22nd, two aircraft flying straight and level over the house at speeds greater than Mach 1 generated a total of 14 normal amplitude booms, 7 booms per aircraft. The normal amplitude booms ranged from 0.84 lb_f/ft² to 1.8 lb_f/ft² (see Chapter 6) as measured by microphone channel 194.

Section 4.1: Description of the maneuver used to generate low amplitude booms

Current generation aircraft in straight and level flight are not capable of generating the low amplitude sonic booms that were required for this test. Thus, a unique dive maneuver was used that results in low amplitude sonic booms far forward (10 to 20 miles forward) of the dive point. A description of the dive used to generate low amplitude sonic booms was documented by Edward Haering of NASA's Dryden Flight Research Center in a report given at the International Sonic Boom Forum¹. A portion of the report describing the maneuver is quoted below:

“The inspiration for producing low overpressure N-wave sonic booms originated with the recent measurement of a sonic boom generated by a sounding rocket upon descent. This vehicle was in a very steep dive at a high altitude and low Mach number when it generated the sonic boom that hit the recorder. Sonic

¹ Edward A. Haering, Jr., James W. Smolka, James E. Murray, and Kenneth J. Plotkin, “Flight Demonstration Of Low Overpressure N-Wave Sonic Booms And Evanescent Waves”, International Sonic Boom Forum, State College, Pennsylvania, USA, July 21-22, 2005.

booms of this type were desired for recording and analysis, so the sonic boom propagation code PCBoom4 was used to look at similar trajectories. Because additional flights of this sounding rocket would be infrequent or nonexistent, alternative available aircraft trajectories were modeled with a multitude of PCBoom4 runs. An aircraft in a steep dive at a high supersonic Mach number was found to generate low overpressures far forward of the dive point. It is hypothesized that these low amplitude booms could be used for human acceptability studies leading to a supersonic aircraft quiet enough for overland flight.”

“The current dive profile involves flying at a level attitude, high subsonic speed, and altitude of nearly 50,000 ft. The aircraft is rolled to an inverted attitude; a positive g pull to the desired dive angle of 53° downward then is initiated, while the throttle is pulled to the idle position to avoid excessive speed. When the desired dive angle is reached, the aircraft is rolled to an upright attitude, and a Mach number of approximately 1.1 is achieved. At an altitude of 38,000 ft a pull-up is executed to recover the aircraft at an altitude of approximately 32,000 ft. The F/A-18B aircraft has an angle-of-attack limit in this supersonic flight regime, so angle of attack is closely monitored. The F/A-18 avionics allows a dive point to be displayed on the head-up display (HUD), which greatly aids in maintaining the proper dive angle and heading.”

Photographs illustrating the F/A-18B at various stages of a dive, as viewed from the test house, are shown in Figures 4.1 through 4.4. The dive profile is illustrated in Figure 4.5. More information regarding the dive maneuver is available upon request.

Section 4.2: Daily waypoints for dives and weather considerations

As stated in the previous section, low amplitude booms occur at receiver locations far forward of the dive point location. The receiver location is about 10 to 20 miles forward of the dive point, depending on weather conditions and desired boom amplitudes. This large propagation distance allows the boom to attenuate before reaching the receiver. The amplitude of a low boom observed at the receiver location, in this case the test house, was adjusted by changing the relative location between the aircraft dive and the house. However, besides the relative distance between dive and receiver, the boom amplitude is also sensitive to atmospheric absorption and atmospheric refraction caused by temperature gradients and wind. Thus, the GPS waypoints where the dives were initiated were not only selected based on desired boom amplitudes but were also updated daily based on the atmospheric conditions measured each morning (Appendix I).

NASA Dryden personnel determined the GPS waypoints for the dives from PCBoom4 runs prior to the flights using weather data measured each morning. A weather balloon was launched at about 3:00 am to determine if weather conditions were favorable. If upper atmosphere conditions were not favorable as determined by the 3:00 am weather balloon, or if winds at the measurement house were too high, the flights for that day were canceled. If conditions were favorable, the atmospheric conditions measured by the 3:00

am weather balloon were used to generate initial dive point locations. A second balloon launch would occur later in the morning. The data from this late morning balloon were used to refine and finalize the dive point locations for the two measurement sessions. The final dive point locations for each flight are summarized in Table 4.2. The measured weather data are documented in Section 4.6.

Section 4.3: Requested low boom amplitudes

Four different low boom amplitudes were requested in a random sequence on June 13th through the 21st. These amplitudes were 0.56, 0.33, 0.19, and 0.11 lb_f/ft² and are representative of amplitudes that are believed attainable by low boom aircraft designs. The randomized ordering of the boom amplitudes for each measurement session is summarized in Table 4.4. The daily waypoints for each of these amplitudes, which varied based on atmospheric conditions, are summarized in Table 4.2. The measured overpressures for each sonic boom observed at the house are documented in the Chapter 6 of this report.

Section 4.4: Normal amplitude boom flights

On June 22nd, several normal amplitude booms were measured at the house. These normal amplitude booms were generated by straight and level flight of the F/A-18B aircraft over the test house. Three different flight paths were used to generate the normal amplitude booms on this day. All three flight paths requested the aircraft fly at Mach 1.23 at an altitude of 31,550 ft. The aircraft, once at this speed and altitude, would fly a predetermined heading through a target waypoint. Two different headings and three different target waypoints were used and are summarized in Table 4.3. After passing through the waypoint, the plane would then continue straight and level flight for a few seconds. This portion of straight and level flight, after passing through the waypoint, is the portion of the flight that generated the boom that arrived at the house. The boom amplitudes, predicted by PCBoom, are also listed in Table 4.3 for the different waypoint, heading combinations.

Section 4.5: Aircraft flight data recordings

For most of the flights, the actual flight path of the aircraft was recorded using GPS instrumentation during the flight. These carrier-phase differential GPS data are available upon request. These data can be used to locate the path that the aircraft actually flew relative to the test house GPS location provided in Appendix C. In addition, the 1553 aircraft bus data such as INS, Mach, and altitude are available on request for some of the flights. It should be noted that some or all these data might be subject to ITAR restrictions.

Section 4.6: Daily atmospheric conditions

As mentioned in Section 4.1, several measurements of the atmospheric profile were taken using weather balloons each day to quantify the weather conditions. In addition, a

portable weather station was setup in the back yard of the test house to monitor temperature, wind speed, wind direction, and humidity. The data gathered from these atmospheric profile and backyard weather station measurements are documented in Appendix I. For the backyard weather station measurements, the temperature, wind speed in knots, wind direction, and relative humidity as a percent were recorded at one-minute intervals. For the atmospheric profile measurements, the following data are included as a function of height in the columns of the tables in Appendix I:

- Zft: Geometric (i.e., GPS) altitude in feet
- Hpf: Pressure altitude in feet
- Tmp: Temp in degrees C
- Kts: Wind speed in knots
- DIR: Wind direction
- Grad: Pressure gradient in feet per nautical mile
- GDr: Direction of the pressure gradient
- Rel: Relative humidity as a percentage
- Hum: Absolute humidity in grams of water per kilogram of dry air

Section 4.7: Boom amplitude and direction (BADS) measurements

An outdoor array of microphones was used to measure the direction of the incident sonic boom (Figure 4.6). The microphone array consisted of six pressure sensors spaced several feet apart on a metal frame. The azimuth and elevation of each incident sonic boom were computed from the relative difference in arrival time of the front shock at each pressure sensor and knowledge of the array orientation. The estimates of the incident angles of each sonic boom are available upon request.

Table 4.1: Flights that occurred.

Date	Flight	Aircraft Used	Lead or Trail Aircraft	Two Simultaneous Flights?	Number of Booms Generated by Aircraft	Type of Booms Generated	Measurement	Measurement	Number of Booms Contained in Measurement
							Session	Session Start Time	
6/13/2006	Flight 1		Lead	} Yes	6	Low amplitude booms ¹	1	9:23:20 AM	12
	Flight 2		Trail		6	Low amplitude booms ¹			
	Flight 3		Lead	} Yes	6	Low amplitude booms ¹	2	11:00:14 AM	12
	Flight 4		Trail		6	Low amplitude booms ¹			
6/15/2006	Flight 5			No	6	Low amplitude booms ¹	3	10:58:34 AM	6
6/16/2006	Flight 6		Lead	} Yes	6	Low amplitude booms ¹	4	9:29:18 AM	8
	Flight 7		Trail		2*	Low amplitude booms ¹			
	Flight 8		Lead	} Yes	6	Low amplitude booms ¹	5	11:03:41 AM	12
	Flight 9		Trail		6	Low amplitude booms ¹			
6/20/2006	Flight 10		Lead	} Yes	6	Low amplitude booms ¹	6	9:52:28 AM	12
	Flight 11		Trail		6	Low amplitude booms ¹			
	Flight 12		Lead	} Yes	6	Low amplitude booms ¹	7	11:11:31 AM	12
	Flight 13		Trail		6	Low amplitude booms ¹			
6/21/2006	Flight 14		Lead	} Yes	6	Low amplitude booms ¹	8	9:26:11 AM	12
	Flight 15		Trail		6	Low amplitude booms ¹			
	Flight 16		Lead	} Yes	6	Low amplitude booms ¹	9	10:56:31 AM	12
	Flight 17		Trail		6	Low amplitude booms ¹			
6/22/2006	Flight 18		Lead	} Yes	7	Normal amplitude booms ²	10**	9:25:30 AM	4
	Flight 19		Trail		7	Normal amplitude booms ²		9:39:45 AM 10:00:04 AM 10:05:29 AM 10:14:11 AM	6 1 2 1

¹ peak overpressures ranged from 0.05 lbf/ft² to 0.80 lbf/ft². Produced by a maneuver of an F/A-18 aircraft described in Section 4.1.² peak overpressures ranged from 0.4 lbf/ft² to 1.80 lbf/ft². Produced by straight and level flight of an F/A-18 aircraft over the house at speeds greater than Mach 1.

* avionics problems in the aircraft resulted in an early return to base, and limited the number of booms produced by this aircraft to 2

** the measurement system was started and stopped multiple times during measurement session 10 to alter the sample rate of the acquisition system

Table 4.2: Daily dive maneuver waypoints for the four different low boom amplitude requests.

	6/13/2006			6/15/2006			6/16/2006			6/20/2006			6/21/2006		
	Latitude	Longitude		Latitude	Longitude		Latitude	Longitude		Latitude	Longitude		Latitude	Longitude	
Waypoint 1 (0.56 psf)	N34:53:47	W117:48:52		N34:55:48	W117:49:57		N34:55:14	W117:48:44		N34:54:27	W117:47:50		N34:55:14	W117:49:25	
Waypoint 2 (0.33 psf)	N34:52:17	W117:42:51		N34:54:54	W117:43:23		N34:55:14	W117:44:02		N34:53:47	W117:41:03		N34:54:33	W117:43:42	
Waypoint 3 (0.19 psf)	N34:51:42	W117:41:34		N34:54:49	W117:42:38		N34:55:14	W117:41:07		N34:53:42	W117:39:36		N34:53:11	W117:40:03	
Waypoint 4 (0.11 psf)	N34:51:29	W117:40:17		N34:54:47	W117:42:27		N34:55:14	W117:39:09		N34:53:59	W117:38:42		N34:53:05	W117:38:59	

Table 4.3: Flight conditions of the normal amplitude boom flights

Amplitude (lb _f /ft ²)	Altitude (ft)	Mach	Heading, magnetic (degrees)	Heading, true (degrees)	Target Waypoint (degree:min:sec)
1.21	31,550	1.23	256	270	34:59:07 N -117:41:43 E
1.17	31,550	1.23	256	270	34:52:48 N -117:41:44 E
1.41	31,550	1.23	79	90	34:58:15 N -118:07:38 E

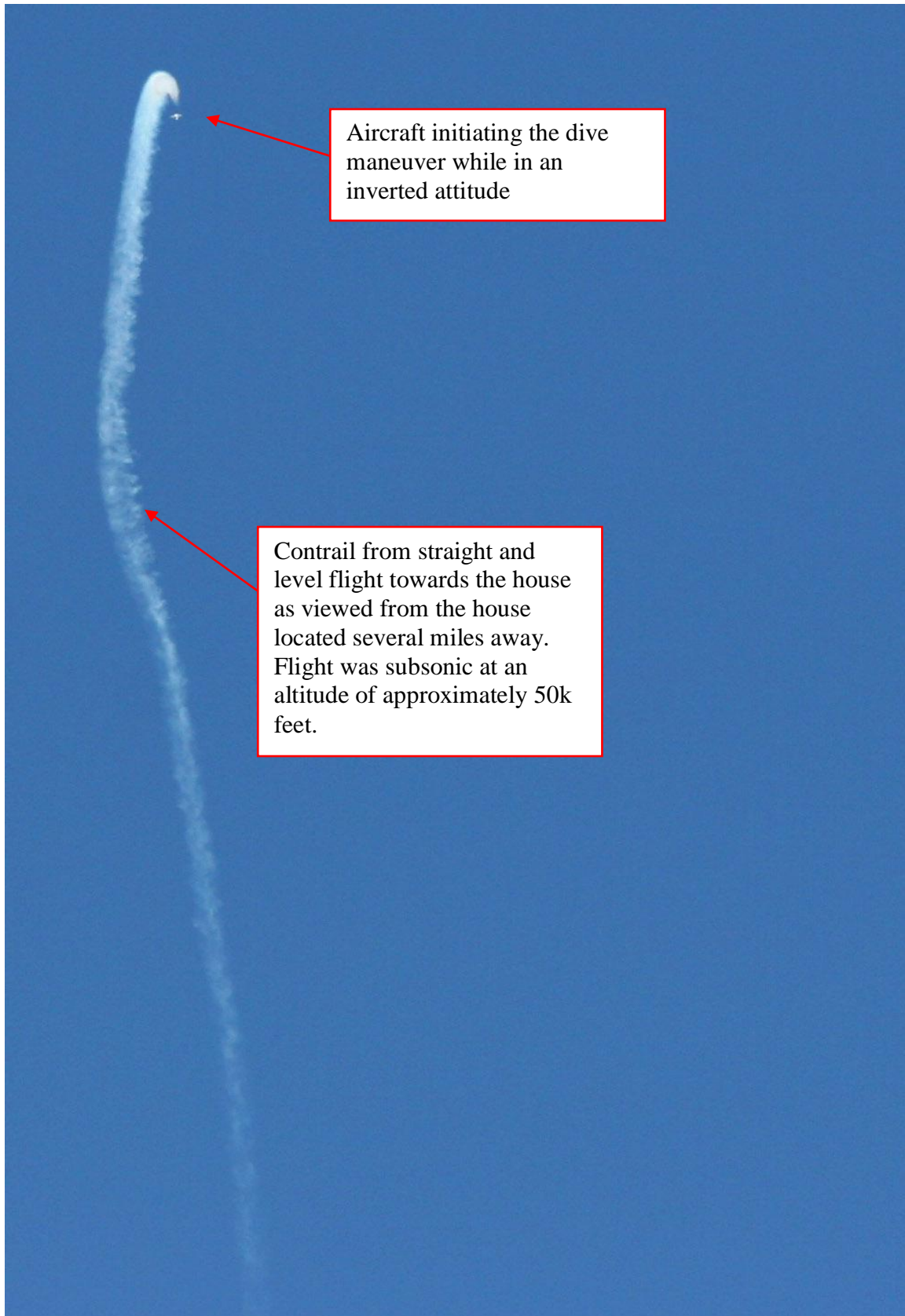


Figure 4.1: F/A-18B is initiating a 53-degree dive after rolling to an inverted position.

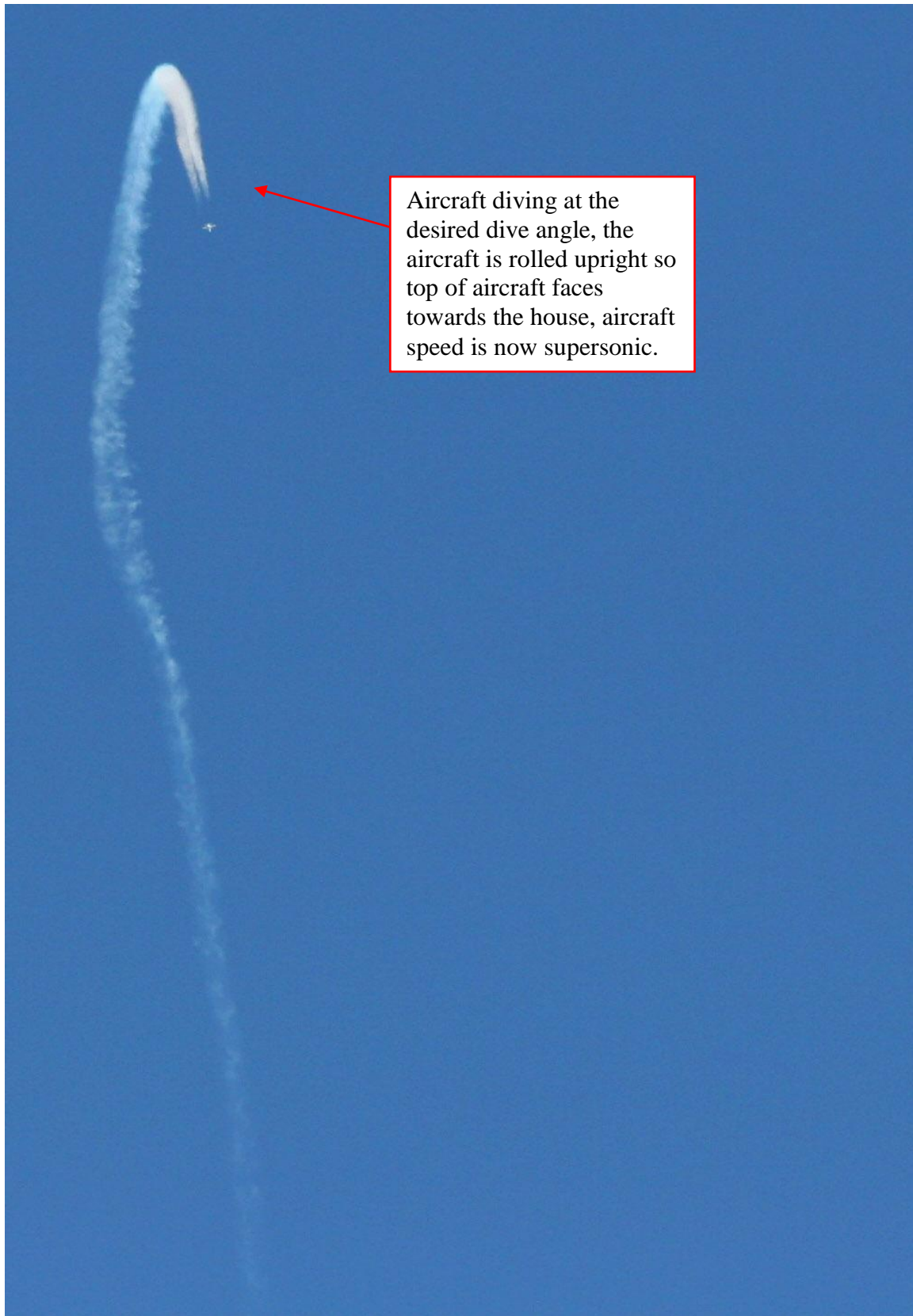


Figure 4.2: F/A-18B aircraft is rolled upright while in a dive at an angle of 53 degrees.



Figure 4.3: F/A-18B throttling up near the end of the 53 degree dive.



Figure 4.4: F/A-18B pulling out at the end of a dive.

NASA Dryden low boom maneuver

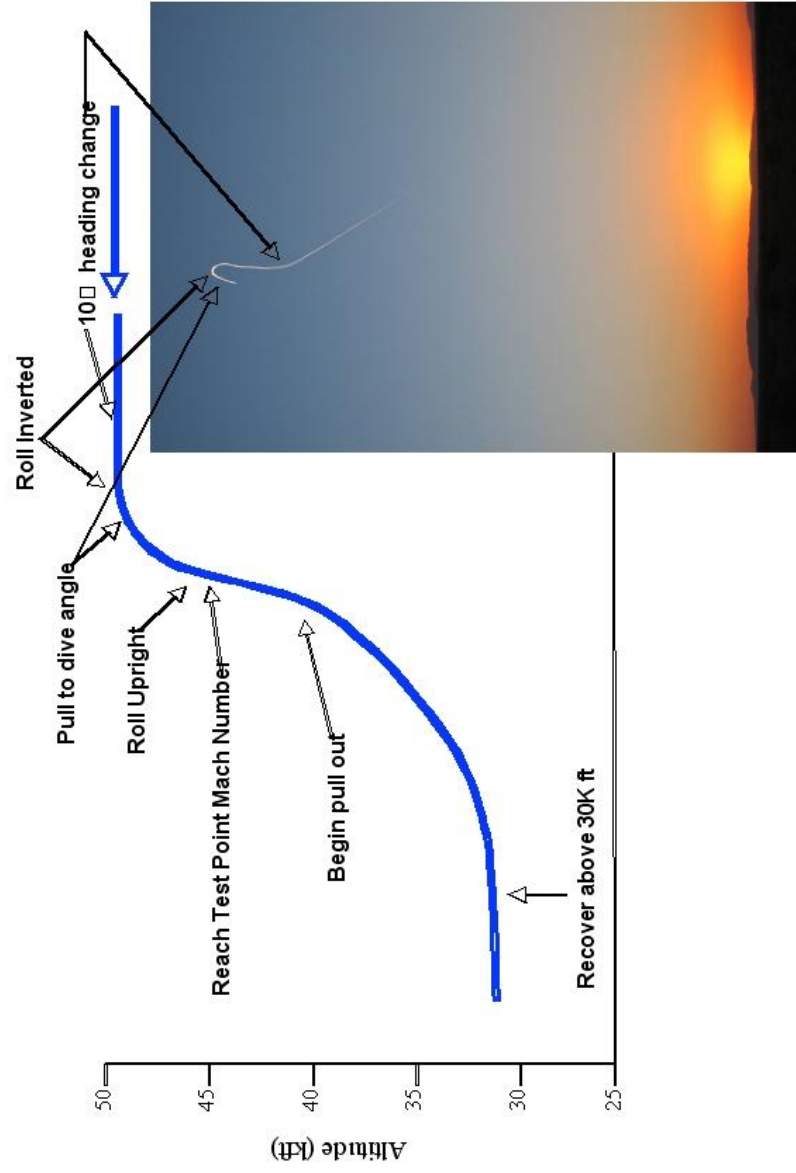


Figure 4.5: Illustration of the dive maneuver.

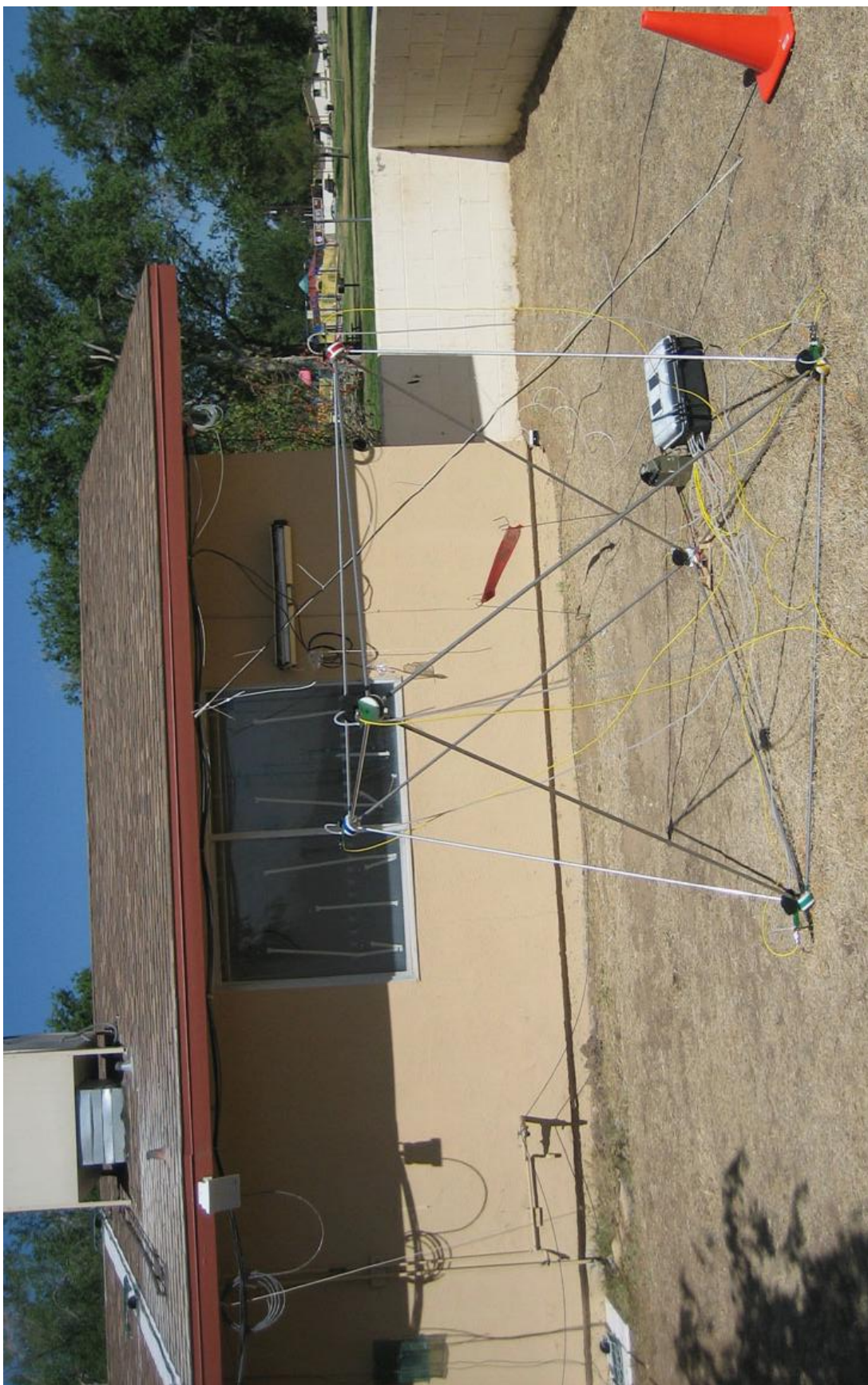


Figure 4.6: System used to measure the boom direction and amplitude.

CHAPTER 5: HOUSE CHARACTERIZATION TESTS

Several tests were performed in March 2006 and June 2006 to characterize the house's structural acoustic response to excitations other than the sonic booms documented in Chapter 4. These simple tests were performed to gather data for validation of models of the house and were designed to measure the response of the house's structure or acoustic spaces to simple excitations, such as acoustic balloon pops or point force excitation from a shaker. For all the tests performed in June 2006, the data acquisition system documented in Chapter 3 was used to record the responses of all 288 channels. The exception to this is the measurements that were made in March 2006 where only a subset of transducers was used. This subset of transducers used in March 2006, and the relevant locations, will be discussed in detail in Section 5.4 of this chapter.

Section 5.1: June 2006 acoustic characterization (reverberation time and impulse response measurements)

Reverberation time measurements were made in the two instrumented bedrooms and the indoor subjective room using a Brüel and Kjær Type 2231 sound level meter with Type 1625 octave-band filter module running reverberation processor software BZ 7108. The serial numbers of the sound level meter, the octave-band filter module, and the Type 4134 microphone attached to the sound level meter were 1413682, 1418440, and 478911, respectively. These instruments were sent to Simco for calibration prior to use in this test. The calibration expiration on these instruments was March 20, 2007. A Mackie studio speaker was attached to the output of the sound level meter to generate the required band-limited pulse of sound. The speaker was placed close to one of the walls in the room, facing the wall at an oblique angle. The sound level meter was located at a height of about 4 feet from the floor and was placed near the middle of the room.

The sound level meter automatically generates a band-limited pulse of sound, measures the reverberation response of the acoustic space, and computes and stores the EDT, T(20), and T(30) in a user-defined range of one-third-octave bands. Measurements of these quantities were made in each of the one-third-octave bands ranging from 63 Hz to 5,000 Hz. Measurements at lower frequencies were not possible because the lower limit of the BZ 7108 software is 63 Hz. Reverberation measurements were made for different acoustic configurations of the rooms, corresponding to the various different room configurations documented in Chapter 3, Section 3.6.

The following configurations were recorded using the sound level meter and are documented in Appendix J:

- Subjective room
 - No people in the chairs
 - 5 people seated in chairs
- Front bedroom
 - Nominal foam configuration (6 mattress pads)
 - Reduced foam configuration (2 mattress pads on the floor)

- Back bedroom
 - Nominal foam configuration (5 mattress pads), window closed
 - Nominal foam configuration (5 mattress pads), window open
 - Increased foam configuration (9 mattress pads), window closed
 - Increased foam configuration (9 mattress pads), window open

For each configuration, the reverberation time was measured twice to ensure that a reliable measurement was made. Neither the sound level meter nor the speaker was moved between the two repeat tests. The measured values of EDT, T(20), and T(30) are typically in close agreement for the two repeat tests of any of the eight configurations listed above (measurements are shown in Appendix J).

It should be noted that the data acquisition system documented in Chapter 3 was also used to record each of these reverberation tests. While the reverberation tests were performed with the sound level meter, the time histories of all 288 channels were recorded at a sample rate of 12,800 Hz during each of the eight tests identified above. The time and date stamp of the raw data records for each of these tests, recorded by the data acquisition system, is give below:

- Subjective room
 - No people in the chairs (6/14/2006 12:10:17 PM)
 - 5 people seated in chairs (6/14/2006 12:21:39 PM)
 - 12 people seated in chairs (6/15/2006 10:11:14 AM)
- Front bedroom
 - Nominal foam configuration (6/14/2006 11:25:20 AM)
 - Reduced foam configuration (6/20/2006 1:42:20 PM)
- Back bedroom
 - Nominal foam configuration, window closed (6/14/2006 11:33:50 AM)
 - Nominal foam configuration, window open (6/20/2006 2:36:47 PM)
 - Increased foam configuration, window closed (6/20/2006 1:51:13 PM)
 - Increased foam configuration, window open (6/20/2006 2:27:52 PM)

Raw measurement data from each one of these measurements recorded by the data acquisition system are available. The format of the raw data files is discussed in more detail in Chapter 6, Section 6.1.

It should be noted that a reverberation time measurement with 12 people sitting in the subjective chairs in the indoor subjective area was also performed as indicated above. Unfortunately, the battery in the sound level meter died before the EDT, T(20), and T(30) could be logged. Consequently, this measurement of EDT, T(20), and T(30) does not appear in Appendix J. However, this measurement was recorded by the data acquisition system and the data are available in a raw format. Thus, the EDT, T(20), and T(30) could be estimated from the response of the microphones in the subjective area using the raw data recorded by the acquisition system. The time and date stamp for this reverberation time measurement, made with 12 people sitting in the chairs of the subjective room, was 6/15/2006 10:11:14 AM.

In addition to the reverberation time measurements documented above, acoustic impulse response measurements were made outside and inside the house on June 22nd, 2006. For the outdoor acoustic impulse response measurements, the locations of the microphones correspond to those documented in Appendix F and include the location changes identified in Appendix H. Inflated brown paper bags were popped outdoors at several different locations to characterize the outdoor propagation of an acoustic impulse. Paper bags were popped at several locations and corresponded to a location of a microphone, as shown in Appendices F and H. To perform this test, a person stood over one of the microphones facing the house, holding the paper bag at chest level roughly five feet above the ground and popped it. The data acquisition system described in Chapter 3 was used to record the time histories of all 288 transducers for each paper bag pop. The locations of each outdoor paper bag pop, and the date and time stamp of the raw data record, are listed in Table 5.1. The format of the raw data files is discussed in more detail in Chapter 6, Section 6.1.

In addition to the outdoor measurements, inflated balloons were popped inside each of the two instrumented bedrooms to characterize the impulse response of these acoustic spaces. Balloons were also popped in the equipment room to identify the transmission of sound from the equipment room into the bedrooms. Three balloons were popped in each of the rooms at random locations near the center of the room. The data acquisition system described in Chapter 3 was used to record the time histories of all 288 transducers for each balloon pop. The locations of each balloon pop, and the date and time stamp of the raw data records are listed in Table 5.1. Each raw data record for the indoor recordings contains three balloon pops. The format of the raw data files is discussed in more detail in Chapter 6, Section 6.1. It should also be noted that channel 205, a Brüel and Kjær Type 4193 microphone located in the front bedroom, was not measured during these balloon pops as it was relocated outside for measurements made on June 22nd.

Section 5.2: June 2006 structural response characterization

Several walls of the two instrumented bedrooms and the ceiling in the back bedroom were excited using a shaker to characterize the response of the structure to a simple point force excitation. The different excitation locations are illustrated in Appendix K and are listed in Table 5.2. An impedance head was mounted to the shaker using a stinger, and then the impedance head was glued to the walls or ceiling using super glue gel. The use of the impedance head allowed measurement of both acceleration and force at the drive point. The model and serial number of the impedance head and the data acquisition channels to which it was connected are listed in the transducer table in Chapter 3. The shaker used in these tests was a Labworks Inc. model ET-126B, serial number 126-405. The amplifier used to drive the shaker was a Labworks Inc. model PA-138, serial number 138-0598. The signal generator used to create the excitation signal was a Tektronics model AFG310, serial number J315589.

The data acquisition system described in Chapter 3 was used to record the response of the accelerometers while the shaker was exciting the structure at the locations indicated in

Appendix K. The precision condenser microphones were disassembled and packed away for shipment back to NASA LaRC prior to these structural characterization tests and were not recorded. The locations of the horizontal and vertical microphone arrays (Appendix G) during each of these tests varied and are indicated in Table 5.2. For structural response measurements, a band-limited pseudo-random signal generated by the Tektronics signal generator was used to excite the shaker. The sample rate of the acquisition and excitation was varied. Both a high frequency and low frequency excitation bandwidth were used at each measurement point (Table 5.2). The low frequency bandwidth resulted in a usable frequency range from 0 to 500 Hz, with a frequency bin width of 0.25 Hz. The high frequency bandwidth resulted in a usable frequency range from 0 to 2,000 Hz, with a frequency bin width of 1 Hz. The date and time stamp of the raw data record for each excitation location and sampling/excitation parameters are listed in Table 5.2. The format of the raw data files is discussed in more detail in Chapter 6, Section 6.1.

Section 5.3: June 2006 window rattle characterization

In addition to the point force response measurements on the walls and ceiling documented in the previous section, tests were performed to characterize the rattle of the window in the front bedroom (Figure 5.1). Due to time constraints, measurements were only made on the front bedroom window. The Gras microphones hooked up to channels 1 and 2 (Chapter 3) were placed in front of the left and right panes of the window (Figure 5.1). The shaker was mounted to the window at location 5, as illustrated in Appendix K. Tests were performed with both pseudo-random and sine wave excitations (Table 5.2). The excitation level varied from a very low level that did not induce audible rattle up to levels that produced significant rattle. For these tests, all the accelerometers were recorded; however, only the two microphones illustrated in Figure 5.1 were recorded as the other microphones were packed away for shipping. The date and time stamp of the raw data record for each excitation location and sampling/excitation parameters are listed in Table 5.2. The format of the raw data files is discussed in more detail in Chapter 6, Section 6.1.

Section 5.4: March 2006 pre-tests

A series of pre-tests were conducted in March 2006 to characterize the structural response of the test house prior to the test in June 2006. Pretest objectives were to instrument the house with a subset of transducers, identify expected response levels, ensure that transducer sensitivity was high enough to yield response levels significantly higher than the transducer self noise, and to gain some experience with the transducers and data acquisition system. These tests were performed with a subset of instrumentation that is listed in Table 5.3. The transducers were located in the two instrumented bedrooms and the subjective seating area. The locations where this instrumentation was placed in March differed from the locations documented in Chapter 3 for the June tests, and is illustrated in Appendix L.

Six low amplitude sonic booms were measured at the house during this pretest in March 2006. The waypoints of the dive maneuver for the plane used for this pretest are not known and, consequently, are not documented in this report. Additionally, the expected boom amplitudes predicted by PCBoom prior to the flights are not known for this pretest. The responses measured at the house due to the six sonic booms impacting the house are contained in a raw data record time and date stamped 3/29/2006 1:42:01 PM. This raw data record is formatted similar to the ones for the June 2006 tests documented in Chapter 6; however, it contains only 56 channels and 32,768 samples per channel per file (see Chapter 6, Section 6.1 for a discussion of the raw data format).

In addition to the response measurements of the house due to sonic boom impact, several characterization tests were also done with an impact hammer. The impulse response of the walls and windows in the two bedrooms was measured. The walls and windows were struck with the impact hammer while the data acquisition system recorded the response of the transducers, as described in Appendix L. The raw data for the impact measurements on the walls are contained in a raw data record date and time stamped 3/29/2006 5:16:21 PM. The raw data for the impact measurements on the windows are contained in a raw data record date and time stamped 3/29/2006 5:23:02 PM. Verbal notes about which windows and walls were being struck were called out during the recording, and should be audible in the microphone responses contained in the two raw data records.

Table 5.1: Locations and timestamps of the bag/balloon pops

Date/Time Stamp	House Location	Sample Rate (Hz)	June 22 nd Impulse Location*
6/22/2006 11:42:15 AM	Outside	25600	Over Microphone 190
6/22/2006 11:43:51 AM	Outside	25600	Over Microphone 190
6/22/2006 11:44:28 AM	Outside	25600	Over Microphone 190
6/22/2006 11:45:20 AM	Outside	25600	Over Microphone 190
6/22/2006 11:46:05 AM	Outside	25600	Over Microphone 190
6/22/2006 11:47:12 AM	Outside	25600	Over Microphone 188
6/22/2006 11:47:50 AM	Outside	25600	Over Microphone 188
6/22/2006 11:48:39 AM	Outside	25600	Over Microphone 188
6/22/2006 11:49:57 AM	Outside	25600	Over Microphone 203
6/22/2006 11:50:25 AM	Outside	25600	Over Microphone 203
6/22/2006 11:51:10 AM	Outside	25600	Over Microphone 203
6/22/2006 11:52:04 AM	Outside	25600	East of Microphone Array
6/22/2006 11:52:37 AM	Outside	25600	East of Microphone Array
6/22/2006 11:53:27 AM	Outside	25600	Over Microphone 187
6/22/2006 11:54:26 AM	Outside	25600	Over Microphone 187
6/22/2006 11:56:00 AM	Outside	25600	Over Microphone 194
6/22/2006 11:56:36 AM	Outside	25600	Over Microphone 194
6/22/2006 11:57:13 AM	Outside	25600	Over Microphone 194
6/22/2006 12:07:07 PM	Front Bedroom	25600	Three pops near middle of room
6/22/2006 12:08:29 PM	Back Bedroom	25600	Three pops near middle of room
6/22/2006 12:11:05 PM	Equipment Room	25600	Three pops near middle of room

* Locations given are relative to the outdoor microphone locations for June 22nd documented in Appendix H.

Table 5.2: Shaker excitation test summary

Date Stamp			Shaker Mount Location*	Sampling Parameters			Excitation Parameters			Vertical Microphone Array Location [#]	Horizontal Microphone Array Location [#]	Other Notes
Date	Time	Sampling Frequency (Hz)		Ensemble Length	Delta Frequency (Hz)	Sampling Frequency (Hz)	Excitation Type	Points per Pseudo-random Sequence				
6/21/2006	4:06:34 PM	Location 1	4096	4096	1	4096	pseudo-random	4096	horiz pos B	vertical pos C	1	
6/21/2006	4:08:22 PM	Location 1	4096	4096	1	4096	pseudo-random	4096	horiz pos B	vertical pos C	1	
6/21/2006	4:10:10 PM	Location 1	4096	4096	1	4096	pseudo-random	4096	horiz pos B	vertical pos C	1	
6/21/2006	4:47:38 PM	Location 2	4096	4096	1	4096	pseudo-random	4096	horiz pos B	vertical pos C	1	
6/23/2006	6:29:38 AM	Location 2	4096	4096	1	4096	pseudo-random	4096	horiz pos B	not used	1	
6/23/2006	6:42:29 AM	Location 3	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	6:46:09 AM	Location 3	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	6:49:12 AM	Location 3	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	8:03:59 AM	Location 4	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	8:09:18 AM	Location 4	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	8:35:07 AM	Location 5	12800	8192	1.5625	n/a	30 Hz sine wave	n/a	horiz pos C	not used	3	
6/23/2006	8:38:19 AM	Location 5	12800	8192	1.5625	n/a	30 Hz sine wave	n/a	horiz pos C	not used	4	
6/23/2006	8:39:58 AM	Location 5	12800	8192	1.5625	n/a	30 Hz sine wave	n/a	horiz pos C	not used	5	
6/23/2006	8:41:15 AM	Location 5	12800	8192	1.5625	n/a	30 Hz sine wave	n/a	horiz pos C	not used	6	
6/23/2006	8:45:44 AM	Location 5	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	7	
6/23/2006	8:49:54 AM	Location 5	4096	16384	0.25	4096	pseudo-random	4096	horiz pos C	not used	8	
6/23/2006	8:52:56 AM	Location 5	4096	16384	0.25	4096	pseudo-random	4096	horiz pos C	not used	9	
6/23/2006	9:23:59 AM	Location 6	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	9:21:11 AM	Location 6	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	6:29:27 AM	Location 6	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	10:00:51 AM	Location 7	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	10:03:20 AM	Location 7	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	10:26:57 AM	Location 8	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	10:28:09 AM	Location 8	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	10:31:06 AM	Location 8	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	11:22:05 AM	Location 9	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	
6/23/2006	11:24:33 AM	Location 9	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	11:33:16 AM	Location 10	4096	4096	1	4096	pseudo-random	4096	horiz pos C	not used	1	
6/23/2006	11:34:59 AM	Location 10	1024	4096	0.25	1024	pseudo-random	4096	horiz pos C	not used	2	

Notes:

* See appendix K

#

See appendix G

1 High frequency structural response

2 Low frequency structural response

3 Front bedroom window rattle test, low excitation level, no rattle, Gras microphones 1 and 2 were placed in front of window

4 Front bedroom window rattle test, mid-low excitation level, some rattle, Gras microphones 1 and 2 were placed in front of window

5 Front bedroom window rattle test, mid-high excitation level, some rattle, Gras microphones 1 and 2 were placed in front of window

6 Front bedroom window rattle test, high excitation level, lots of rattle, Gras microphones 1 and 2 were placed in front of window

7 Front bedroom window rattle test, low excitation level, no rattle of window, Gras microphones 1 and 2 were placed in front of window

8 Front bed window rattle test, high excitation level, window rattled significantly, Gras microphones 1 and 2 were placed in front of window

9 Front bed window rattle test, low excitation level, no rattle of window, Gras microphones 1 and 2 were placed in front of window

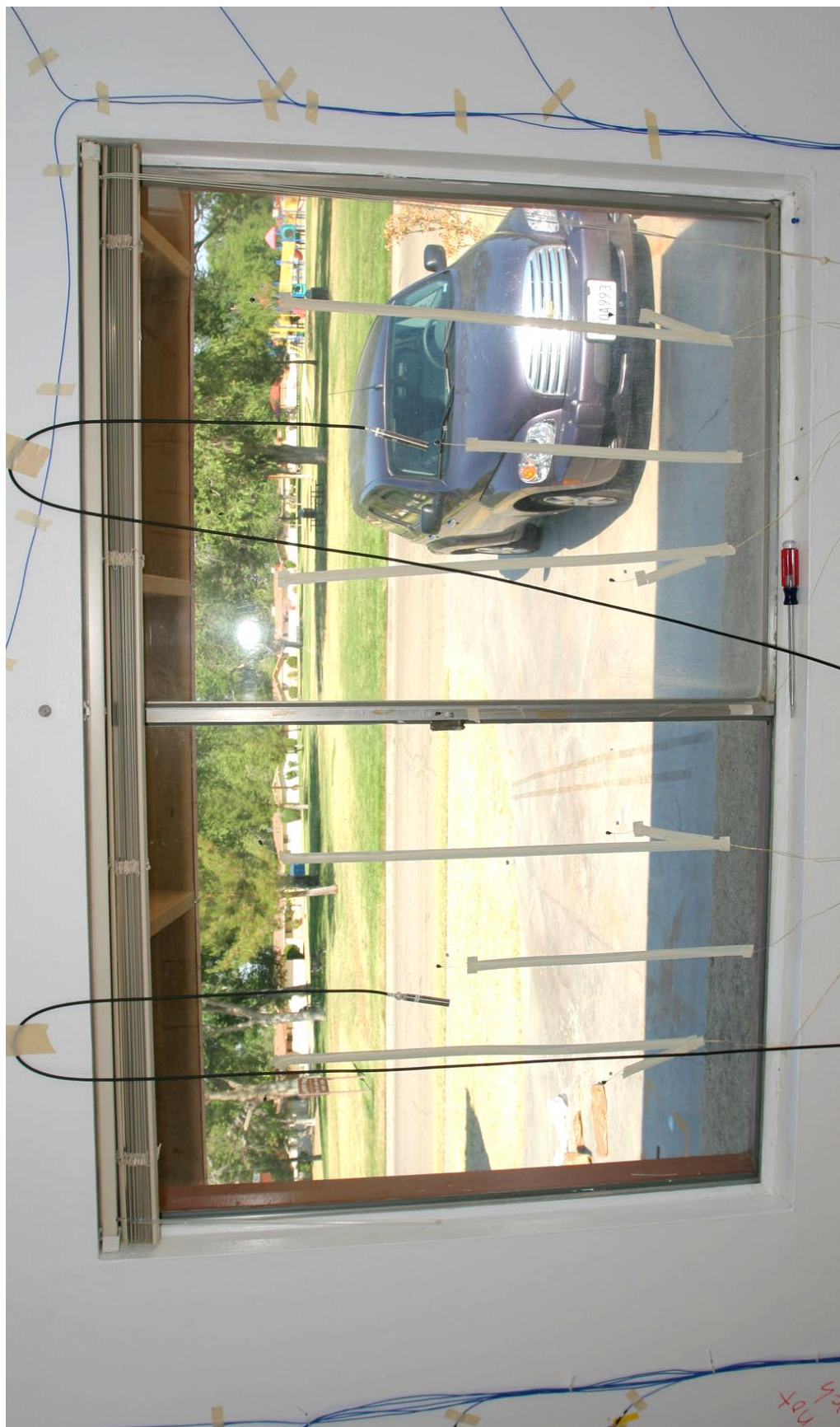


Figure 5.1: Location of the microphones hung in front of the window for the window rattle tests on June 23rd, documented in Table 5.2.

CHAPTER 6: VIBRO-ACOUSTIC DATA FORMATS

In this chapter, the data and data formats that are available for distribution are discussed. In addition, illustrations of some select data are documented and discussed. The data acquisition system and software that was used to collect the data are documented in Chapter 3.

Section 6.1: Sampling parameters and raw data formats

The sampling parameters and raw data formats are discussed in this section for both the sonic boom measurements and the characterization tests documented in Chapters 4 and 5, respectively.

Subsection 6.1.1: Sampling parameters and raw data formats for the June 2006 sonic boom measurements

Approximately 40 minutes of continuous data were recorded for each of the eight sonic boom measurement sessions documented in Chapter 4. All sonic boom measurement sessions were recorded at a sample rate of 25,600 Hz except for booms 11 and 14 on June 22nd, which were recorded at a sample rate of 51,200 Hz, as indicated in Table 6.1. Continuous time data were acquired using ensembles that were 32,768 samples long. Each ensemble of time was written to disk as a separate file, resulting in roughly 1,900 raw data files per measurement session. The time data are continuous from ensemble to ensemble. Throughput benchmarks were completed to ensure data continuity prior to use of the data acquisition system in this test. Data continuity was demonstrated up to a sample rate of 80,000 Hz and 288 channels for long duration acquisitions. Thus, continuous time data records longer than 32,768 samples can be constructed by reading and appending data from sequential raw data files. It should be noted that the ensemble length, sample rate, and channel count used during the characterization tests documented in Chapter 5 varied from those used for the sonic boom measurements. These changes to channel count, sampling frequency, or number of points per ensemble are discussed in Subsection 6.1.2. However, the data format discussed in this section still applies to the characterization tests.

Each raw data file, containing one ensemble of time data (32,768 samples) for all of the measurement channels, is written to disk as un-scaled, signed 32 bit integers (int32 format). The machine format of each raw data file is IEEE floating point with big-endian byte ordering. The first two int32's stored in the raw data files respectively indicate the number of channels and number of samples contained in the data file. The remaining int32's contained in the data files correspond to the time histories of the measurement channels. For the NI 4472B data acquisition cards, the scale factor to convert from the signed int32's to voltage is 9.3132257462E-9. An example of how to read the voltage data into Matlab from the raw data files for one channel is:

```
% Define the file and path names
PathName = 'c:\PutPathToFileHere\';
FileName = 'PutFileNameHere';
```

```

% Open the file for read access
fid = fopen([PathName,FileName], 'r', 'ieee-be');
% Read the number of channels and number of
% samples contained in the file
NumChannels = fread(fid,1,'int32');
NumSamples = fread(fid,1,'int32');
% Define the channel to be read from the file
ChannelToRead = 196;
% Seek to the position in the file containing the
% data for the defined channel. Note that the seek
% is performed from the current position in the file
fseek(fid, (ChannelToRead-1)*NumSamples*4,0);
% Define the scaling from int32 to voltage
Scaling = 9.3132257462E-9;
% Read the data from the file and scale it to voltage
ChannelData = fread(fid,NumSamples,'int32')*Scaling;

```

The above Matlab example would read data for channel 196 from a raw data file defined by the variables “PathName” and “FileName” and return the voltage time history for that channel to the Matlab vector “ChannelData”. It should be noted that an int32 is 4 bytes long, which is why the **fseek** command in the above script includes a multiplication by four. As can be inferred from the above script, the order of the channel data in the raw data files is as given in Table 6.2.

Subsection 6.1.2: File naming convention

The data recorded to raw data files are stored in files with names that included a time and date stamp corresponding to the starting time and date of the measurement session as well as the ensemble number. The time and date stamps for each of the sonic boom measurement sessions are shown in Table 6.1 and Table 4.1 of Chapter 4. The file naming convention of the raw data files for the measurement session at 9:23:20 AM on June 13, 2006 is shown in Figure 6.1. All the ensembles of time data are stored in these individual files, and are placed into a time and date stamped directory located in the “Booms” parent directory. The directory structure of the “Booms” parent directory is illustrated in Figure 6.2, which shows all the measurement sessions that were recorded during the six days of boom measurements. Each subdirectory in the “Booms” directory contains a file naming convention similar to that illustrated in Figure 6.1. Table 6.1 can be cross-referenced with Tables 4.3 and 4.2, respectively, to identify the requested boom amplitudes and waypoints for each of the measured booms.

The data acquisition system was started at the beginning of the measurement session and ran continuously until after the session’s last boom. Thus, with only 12 to 14 sonic booms measured per 40-minute session, much of the raw data are measurements of the ambient noise. To aid finding the sonic boom events in the raw data records, the ensemble range when each sonic boom occurred is documented in Table 6.1 for each measurement session. The total size of all the raw data is roughly 710 GB. The size of a single raw data file, containing 288 channels and 32,768 samples, is 36 MB. There are typically about 1900 raw data files per measurement session, resulting in roughly 70 GB of raw data per measurement session.

Subsection 6.1.3: Summary of the raw data that is available including sonic boom measurements, characterization tests and calibrations

In addition to the data recordings for the sonic booms documented above, data were recorded for the characterization tests documented in Chapter 5 and daily calibration of the precision microphone documented in Chapter 3, Section 3.4. The raw data format for these measurements is nearly identical to that described in the above section and outlined in Table 6.2. The only variation in the data written to the raw data files for these calibration and characterization measurements, when compared to the data recorded for the sonic boom measurements, is the:

- Number of samples per ensemble of time data
- Number of channels recorded
- Sample rate of the acquisition

The variations of those parameters are documented in Chapter 5 and Tables 5.1 and 5.2, and are summarized in Table 6.3. The file naming convention used for these files is the same as that described in Subsection 6.1.2 and includes a date and time stamp as well as an ensemble number. In the case of characterization tests or calibrations, the date and time stamp corresponds to the starting time and date of the characterization test or calibration sequence.

Section 6.2: Matlab formatted data: time histories

For convenient distribution, the voltage time histories for all 288 channels and 112 booms measured during June 2006 were extracted from the raw data files and stored in Matlab version 7 files. One Matlab file containing time histories for all 288 channels was created for each of the 112 sonic booms (Table 6.1). The Matlab files contain between 11.52 and 20.48 seconds of time history data (Table 6.1), where the front shock of the sonic boom occurs roughly 1 second into the Matlab data record. Thus, these Matlab data files contain a short pre-boom ambient response, the boom event, and roughly 10 seconds of post boom response data.

In each file, the voltage versus time for each channel is stored into separate arrays named “Channel_N_Voltage”, where N indicates the channel number and ranges from 1 to 288. This allows individual channels to be loaded from the files into Matlab using the load command as follows:

```
load 'Run_6_13_2006_11_00_14 ...  
AM_Boom1_AllChans_Ensembles_300 to 308.mat' ...  
Channel_196_Voltage
```

This would load the voltage time history for channel 196 out of the Matlab data file for the first boom of the second session on June 13, 2006. Consequently, memory requirements can be easily managed with this Matlab data set by only loading the required time data out of the desired Matlab data files. The naming convention of the Matlab data files is identified in Table 6.1. The ensemble range contained in these data

files is also indicated in that table. Uncalibrated voltages were stored into these files, thus the calibration data presented in Chapter 3 must be used to extract the desired engineering units. In addition to the voltage time histories for each channel, each Matlab data file also contains variables that identify the:

- Sampling frequency
- Time vector
- Scaling that was used to convert from int32 (contained in the raw data files) to voltage
- Time and date stamp of the data in the file

The Matlab data set for all 112 sonic booms and all 288 measurement channels is approximately 23.7 GB in size, which is significantly more portable than the raw data set documented in Section 6.1. A smaller Matlab data set was also created that contains the time history data of only the precision microphone channels, channels 1 through 3, 61, 62, 129, 136, 177 through 207, and 282 through 288. The array naming convention contained in these Matlab files is the same as that described above for the complete data set. The total size of this “microphone only” Matlab data set for all 112 sonic boom measurements is approximately 5 GB. If requests for time history data are made by external organizations, it is recommended that the request for the smallest data set, based on research requirements, be made.

Section 6.3: Matlab formatted data: spectra

Both narrow band and one-third-octave band spectra were computed for the 288 transducers for all 112 sonic boom events. Transducer sensitivities from Chapter 3 were applied to the voltage time histories prior to computation of the spectra. These spectra were computed from truncated time histories, where the beginning of the time histories corresponded to the arrival of the front shock of the sonic boom at channel 190 and the end of the time histories was 6.40 seconds (or 163,840 samples) later. The sample and time index corresponding to the arrival of the front shock at channel 190 for each reduced Matlab data set documented in Section 6.2 is listed in Table 6.4. An example truncated time history for channel 206 is illustrated in Figure 6.3a. Half of a Hanning window was applied to this truncated time history to drive the end of the response to zero to avoid the effects of taking an FFT over a finite, non-zero time series. The window that was used and a typical truncated and windowed time history are illustrated in Figures 6.3b and 6.3c, respectively. The FFT of the truncated and windowed time history was computed in Matlab, and the power spectral density was found from this FFT. The narrow band power spectral density of the truncated and windowed time history illustrated in Figure 6.3c is illustrated in Figure 6.4a. The narrow band power spectrum was then summed between the lower and upper one-third-octave band limits to find the one-third-octave band power spectrum illustrated in Figures 6.4b. These spectral data are available for distribution in a Matlab format; the data set size that includes the narrow band and one-third-octave band spectra is roughly 14.5 GB for all 288 channels and 112 sonic booms.

Section 6.4: Some example data

In this section, example data from the sonic boom measurements are presented and discussed. This analysis is not meant to be exhaustive, but instead illustrates different ways the data can be considered, illustrates data quality, and documents some findings that have resulted from the analysis completed to date. For reference purposes, the peak overpressure recorded by the microphone connected to channel 194 is listed in Table 6.5 for each of the 112 sonic booms. The sensitivity of channel 194 used to convert from voltage to pressure is also listed in Table 6.5.

Plots of the time history of the transducer responses are provided for an indoor microphone, an outdoor microphone, a wall-mounted accelerometer, and a window-mounted accelerometer in Figures 6.5 and 6.6. These responses illustrate typical behavior of a normal amplitude booms from the June 22nd test and a low amplitude boom from one of the other five measurement days. The resonant behavior of the structure is evident when comparing the outside microphone response, which represents the excitation behavior, to the indoor microphone and accelerometer responses. The indoor microphone and accelerometers exhibit damped oscillation in the response that takes awhile to decay. The accelerometer responses contain significantly more high frequency energy than do the indoor or outdoor microphone responses. Also, the peak response of the window-mounted accelerometer is more than an order of magnitude larger than the response of the wall-mounted accelerometer. This is likely due to the lower mass of the window.

When comparing the spectra of the indoor and outdoor microphone responses illustrated in Figures 6.7a and 6.8a, it is interesting to note the difference between the low and high frequency behavior. At frequencies between 1 and 200 Hz, the indoor microphone response tends to be significantly less than the outdoor microphone response for both low amplitude (Figure 6.7) and normal amplitude (Figure 6.8) sonic booms. This outdoor-to-indoor reduction can be attributed to transmission loss of low frequency energy through the structure. The exceptions to this are first at very low frequencies below 2 Hz where there is little difference between the level inside and outside. In addition, at about 16 Hz there is no observable reduction in interior sound level compared to the exterior level. This frequency corresponds to the first mode of the walls of the house, and the transmission loss of the structure should be very low. However, at frequencies above approximately 200 Hz, the indoor microphone response is somewhat higher than the outdoor microphone response. Comparing the accelerometer responses of the walls and windows (Figures 6.7b and 6.8b), the response of the window's power spectrum is three orders of magnitude higher than the wall response across a wide range of frequencies. A detailed look at the time history of the window-mounted accelerometer is illustrated in Figure 6.9. When the window approaches points of maximum acceleration, which corresponds to points of maximum deflection, very high frequency (short period) and high amplitude events are evident in the time history as marked by the arrows. These vibrations are a result of the loosely fit windowpane, discussed in Chapter 2, hitting the frame and causing rattle. It is this high frequency, rattle induced vibration which then radiates from the window into the interior of the house, thus increasing the overall sound

pressure level beyond which would be expected from transmission of the sonic boom through the structure (as observed in Figures 6.7a and 6.8a).

Unique behavior can also be gleaned by comparing the response levels of two transducers in a particular one-third-octave band across all 112 sonic booms. For example, in Figure 6.10, the level of channel 206 (a microphone in the back bedroom) is plotted relative to the level of channel 197 (an outside microphone) in the 8 Hz one-third-octave band. Each dot represents the one-third-octave band spectrum level observed at the two transducers for one of the 112 sonic booms. The black dots correspond to low amplitude booms with the bedroom window closed. The red dots correspond to low amplitude booms with the bedroom window open. The blue dots correspond to normal amplitude booms with the bedroom window closed. Two distinct linear relationships can be identified from this plot. For the case where the window is closed, the interior sound pressure level is 10 dB below the exterior sound pressure level and scales linearly with the outside level (blue and black dots shown in Figure 6.10). When the window is opened, a linear relation between the interior and exterior is still identifiable, however; the level of the interior response is found to be 5 dB higher than the exterior response (red dots in Figure 6.10).

It is also interesting to note how these linearity plots change with frequency. In Figures 6.11 and 6.12, the level of channel 206 is plotted relative to the level of channels 197 and 126, respectively. Channel 197 is an outdoor microphone and channel 126 is a window-mounted accelerometer. In each of these figures, the linearity plots are illustrated for fifteen one-third-octave bands ranging from 5 Hz to 1,600 Hz. These plots were chosen because they represent typical behavior of the interior pressure response with respect to transducers mounted in these locations. It is interesting to note how the behavior of the interior pressure response, channel 206, changes with respect to the outside pressure response as frequency increases (Figure 6.11). At very low frequency, there is a distinct linear relation between inside and outside pressure (Figure 6.11) that is affected by the state of the window. By comparing the red dots to the blue and black dots, the relation between inside and outside pressure level is different depending on whether the window is open or closed. However, above roughly 10 Hz, the state of the window appears to have a negligible effect on the ratio of inside-to-outside pressure (Figure 6.11). It is also interesting to note that as frequency is increased even further, above 50 Hz, the linear relation between the inside and outside pressure level begins to break down. At very high frequency, the 1,600 Hz one-third-octave band, for example, there is no discernable linear relationship between inside and outside sound pressure levels. However, when comparing the inside pressure level to window acceleration level at high frequencies (Figure 6.12), a linear relationship between window vibration level and interior sound pressure level can be identified. As was demonstrated earlier in this section in the look at the time domain response of the window-mounted accelerometer, this trend indicates that window vibration is contributing significantly to the interior pressure response at high frequency.

Table 6.1: Ensemble ranges for locating sonic booms in the raw data files.

Measurement Session Date Stamp	Measurement Session Time Stamp	Measurement Session Number	Pre Boom Ensemble	Ending Ensemble	Number of Ensembles	Sample Rate (Hz)	Duration (Seconds)	Matlab File Name Containing the Reduced Data
6/13/2006	9:23:20 AM	Boom 1	373	381	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom1_AllChans_Ensembles_373 to 381.mat
6/13/2006	9:23:20 AM	Boom 2	541	549	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom2_AllChans_Ensembles_541 to 549.mat
6/13/2006	9:23:20 AM	Boom 3	659	667	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom3_AllChans_Ensembles_659 to 667.mat
6/13/2006	9:23:20 AM	Boom 4	805	813	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom4_AllChans_Ensembles_805 to 813.mat
6/13/2006	9:23:20 AM	Boom 5	947	955	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom5_AllChans_Ensembles_947 to 955.mat
6/13/2006	9:23:20 AM	Boom 6	1135	1143	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom6_AllChans_Ensembles_1135 to 1143.mat
6/13/2006	9:23:20 AM	Boom 7	1230	1238	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom7_AllChans_Ensembles_1230 to 1238.mat
6/13/2006	9:23:20 AM	Boom 8	1413	1421	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom8_AllChans_Ensembles_1413 to 1421.mat
6/13/2006	9:23:20 AM	Boom 9	1537	1545	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom9_AllChans_Ensembles_1537 to 1545.mat
6/13/2006	9:23:20 AM	Boom 10	1679	1687	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom10_AllChans_Ensembles_1679 to 1687.mat
6/13/2006	9:23:20 AM	Boom 11	1820	1828	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom11_AllChans_Ensembles_1820 to 1828.mat
6/13/2006	9:23:20 AM	Boom 12	1959	1967	9	25600	11.52	Run 6_13_2006_9_23_20 AM_Boom12_AllChans_Ensembles_1959 to 1967.mat
6/13/2006	11:00:14 AM	Boom 1	300	308	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom1_AllChans_Ensembles_300 to 308.mat
6/13/2006	11:00:14 AM	Boom 2	396	404	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom2_AllChans_Ensembles_396 to 404.mat
6/13/2006	11:00:14 AM	Boom 3	618	629	12	25600	15.36	Run 6_13_2006_11_00_14 AM_Boom3_AllChans_Ensembles_618 to 629.mat
6/13/2006	11:00:14 AM	Boom 4	735	743	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom4_AllChans_Ensembles_735 to 743.mat
6/13/2006	11:00:14 AM	Boom 5	906	914	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom5_AllChans_Ensembles_906 to 914.mat
6/13/2006	11:00:14 AM	Boom 6	1028	1036	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom6_AllChans_Ensembles_1028 to 1036.mat
6/13/2006	11:00:14 AM	Boom 7	1211	1219	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom7_AllChans_Ensembles_1211 to 1219.mat
6/13/2006	11:00:14 AM	Boom 8	1363	1371	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom8_AllChans_Ensembles_1363 to 1371.mat
6/13/2006	11:00:14 AM	Boom 9	1485	1493	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom9_AllChans_Ensembles_1485 to 1493.mat
6/13/2006	11:00:14 AM	Boom 10	1608	1616	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom10_AllChans_Ensembles_1608 to 1616.mat
6/13/2006	11:00:14 AM	Boom 11	1790	1798	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom11_AllChans_Ensembles_1790 to 1798.mat
6/13/2006	11:00:14 AM	Boom 12	1873	1881	9	25600	11.52	Run 6_13_2006_11_00_14 AM_Boom12_AllChans_Ensembles_1873 to 1881.mat
6/15/2006	10:58:34 AM	Boom 1	152	160	9	25600	11.52	Run 6_15_2006_10_58_34 AM_Boom1_AllChans_Ensembles_152 to 160.mat
6/15/2006	10:58:34 AM	Boom 3	473	481	9	25600	11.52	Run 6_15_2006_10_58_34 AM_Boom2_AllChans_Ensembles_473 to 481.mat
6/15/2006	10:58:34 AM	Boom 5	745	753	9	25600	11.52	Run 6_15_2006_10_58_34 AM_Boom3_AllChans_Ensembles_745 to 753.mat
6/15/2006	10:58:34 AM	Boom 7	1001	1009	9	25600	11.52	Run 6_15_2006_10_58_34 AM_Boom4_AllChans_Ensembles_1001 to 1009.mat
6/15/2006	10:58:34 AM	Boom 9	1258	1266	9	25600	11.52	Run 6_15_2006_10_58_34 AM_Boom5_AllChans_Ensembles_1258 to 1266.mat
6/15/2006	10:58:34 AM	Boom 11	1461	1469	9	25600	11.52	Run 6_15_2006_10_58_34 AM_Boom6_AllChans_Ensembles_1461 to 1469.mat
6/16/2006	9:29:18 AM	Boom 1	149	157	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom1_AllChans_Ensembles_149 to 157.mat
6/16/2006	9:29:18 AM	Boom 2	243	251	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom2_AllChans_Ensembles_243 to 251.mat
6/16/2006	9:29:18 AM	Boom 3	473	481	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom3_AllChans_Ensembles_473 to 481.mat
6/16/2006	9:29:18 AM	Boom 4	559	567	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom4_AllChans_Ensembles_559 to 567.mat
6/16/2006	9:29:18 AM	Boom 5	775	783	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom5_AllChans_Ensembles_775 to 783.mat
6/16/2006	9:29:18 AM	Boom 7	1032	1040	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom7_AllChans_Ensembles_1032 to 1040.mat
6/16/2006	9:29:18 AM	Boom 9	1232	1240	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom9_AllChans_Ensembles_1232 to 1240.mat

Table continued on next page.

Table 6.1: Continued.

Measurement Session Date Stamp	Measurement Session Time Stamp	Measurement Session Boom Number	Pre Boom Ensemble	Ending Ensemble	Number of Ensembles	Sample Rate (Hz)	Duration (Seconds)	Matlab File Name Containing the Reduced Data
6/16/2006	9:29:18 AM	Boom 11	1448	1456	9	25600	11.52	Run 6_16_2006_9_29_18 AM_Boom11_AllChans_Ensembles_1448 to 1456.mat
6/16/2006	11:03:41 AM	Boom 1	372	380	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom1_AllChans_Ensembles_372 to 380.mat
6/16/2006	11:03:41 AM	Boom 2	504	512	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom2_AllChans_Ensembles_504 to 512.mat
6/16/2006	11:03:41 AM	Boom 3	674	682	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom3_AllChans_Ensembles_674 to 682.mat
6/16/2006	11:03:41 AM	Boom 4	807	815	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom4_AllChans_Ensembles_807 to 815.mat
6/16/2006	11:03:41 AM	Boom 5	932	940	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom5_AllChans_Ensembles_932 to 940.mat
6/16/2006	11:03:41 AM	Boom 6	1089	1097	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom6_AllChans_Ensembles_1089 to 1097.mat
6/16/2006	11:03:41 AM	Boom 7	1227	1235	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom7_AllChans_Ensembles_1227 to 1235.mat
6/16/2006	11:03:41 AM	Boom 8	1358	1366	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom8_AllChans_Ensembles_1358 to 1366.mat
6/16/2006	11:03:41 AM	Boom 9	1513	1521	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom9_AllChans_Ensembles_1513 to 1521.mat
6/16/2006	11:03:41 AM	Boom 10	1640	1648	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom10_AllChans_Ensembles_1640 to 1648.mat
6/16/2006	11:03:41 AM	Boom 11	1756	1764	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom11_AllChans_Ensembles_1756 to 1764.mat
6/16/2006	11:03:41 AM	Boom 12	1911	1919	9	25600	11.52	Run 6_16_2006_11_03_41 AM_Boom12_AllChans_Ensembles_1911 to 1919.mat
6/20/2006	9:52:28 AM	Boom 1	88	96	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom1_AllChans_Ensembles_88 to 96.mat
6/20/2006	9:52:28 AM	Boom 2	250	258	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom2_AllChans_Ensembles_250 to 258.mat
6/20/2006	9:52:28 AM	Boom 3	399	407	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom3_AllChans_Ensembles_399 to 407.mat
6/20/2006	9:52:28 AM	Boom 4	522	530	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom4_AllChans_Ensembles_522 to 530.mat
6/20/2006	9:52:28 AM	Boom 5	658	666	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom5_AllChans_Ensembles_658 to 666.mat
6/20/2006	9:52:28 AM	Boom 6	760	768	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom6_AllChans_Ensembles_760 to 768.mat
6/20/2006	9:52:28 AM	Boom 7	925	933	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom7_AllChans_Ensembles_925 to 933.mat
6/20/2006	9:52:28 AM	Boom 8	1059	1067	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom8_AllChans_Ensembles_1059 to 1067.mat
6/20/2006	9:52:28 AM	Boom 9	1139	1147	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom9_AllChans_Ensembles_1139 to 1147.mat
6/20/2006	9:52:28 AM	Boom 10	1298	1306	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom10_AllChans_Ensembles_1298 to 1306.mat
6/20/2006	9:52:28 AM	Boom 11	1443	1451	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom11_AllChans_Ensembles_1443 to 1451.mat
6/20/2006	9:52:28 AM	Boom 12	1585	1593	9	25600	11.52	Run 6_20_2006_9_52_28 AM_Boom12_AllChans_Ensembles_1585 to 1593.mat
6/20/2006	11:11:31 AM	Boom 1	274	282	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom1_AllChans_Ensembles_274 to 282.mat
6/20/2006	11:11:31 AM	Boom 2	376	384	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom2_AllChans_Ensembles_376 to 384.mat
6/20/2006	11:11:31 AM	Boom 3	571	579	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom3_AllChans_Ensembles_571 to 579.mat
6/20/2006	11:11:31 AM	Boom 4	702	710	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom4_AllChans_Ensembles_702 to 710.mat
6/20/2006	11:11:31 AM	Boom 5	824	832	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom5_AllChans_Ensembles_824 to 832.mat
6/20/2006	11:11:31 AM	Boom 6	990	998	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom6_AllChans_Ensembles_990 to 998.mat
6/20/2006	11:11:31 AM	Boom 7	1142	1150	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom7_AllChans_Ensembles_1142 to 1150.mat
6/20/2006	11:11:31 AM	Boom 8	1279	1287	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom8_AllChans_Ensembles_1279 to 1287.mat
6/20/2006	11:11:31 AM	Boom 9	1390	1398	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom9_AllChans_Ensembles_1390 to 1398.mat
6/20/2006	11:11:31 AM	Boom 10	1609	1617	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom10_AllChans_Ensembles_1609 to 1617.mat
6/20/2006	11:11:31 AM	Boom 11	1738	1746	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom11_AllChans_Ensembles_1738 to 1746.mat
6/20/2006	11:11:31 AM	Boom 12	1888	1896	9	25600	11.52	Run 6_20_2006_11_11_31 AM_Boom12_AllChans_Ensembles_1888 to 1896.mat
6/21/2006	9:26:11 AM	Boom 1	238	246	9	25600	11.52	Run 6_21_2006_9_26_11 AM_Boom1_AllChans_Ensembles_238 to 246.mat

Table continued on next page.

Table 6.1: Concluded.

Measurement Session Date Stamp	Measurement Session Time Stamp	Measurement Session Boom Number	Pre Boom Ensemble	Ending Ensemble	Number of Ensembles	Sample Rate (Hz)	Duration (Seconds)	Matlab File Name Containing the Reduced Data
6/21/2006	9:26:11 AM	Boom 2	387	395	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom2_AllChans_Ensembles_387 to 395.mat
6/21/2006	9:26:11 AM	Boom 3	560	568	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom3_AllChans_Ensembles_560 to 568.mat
6/21/2006	9:26:11 AM	Boom 4	714	722	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom4_AllChans_Ensembles_714 to 722.mat
6/21/2006	9:26:11 AM	Boom 5	808	816	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom5_AllChans_Ensembles_808 to 816.mat
6/21/2006	9:26:11 AM	Boom 6	960	968	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom6_AllChans_Ensembles_960 to 968.mat
6/21/2006	9:26:11 AM	Boom 7	1118	1126	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom7_AllChans_Ensembles_1118 to 1126.mat
6/21/2006	9:26:11 AM	Boom 8	1235	1243	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom8_AllChans_Ensembles_1235 to 1243.mat
6/21/2006	9:26:11 AM	Boom 9	1376	1384	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom9_AllChans_Ensembles_1376 to 1384.mat
6/21/2006	9:26:11 AM	Boom 10	1556	1564	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom10_AllChans_Ensembles_1556 to 1564.mat
6/21/2006	9:26:11 AM	Boom 11	1680	1688	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom11_AllChans_Ensembles_1680 to 1688.mat
6/21/2006	9:26:11 AM	Boom 12	1816	1824	9	25600	11.52	Run 6 21 2006 9 26 11 AM_Boom12_AllChans_Ensembles_1816 to 1824.mat
6/21/2006	10:36:31 AM	Boom 1	232	240	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom1_AllChans_Ensembles_232 to 240.mat
6/21/2006	10:36:31 AM	Boom 2	341	349	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom2_AllChans_Ensembles_341 to 349.mat
6/21/2006	10:36:31 AM	Boom 3	545	553	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom3_AllChans_Ensembles_545 to 553.mat
6/21/2006	10:36:31 AM	Boom 4	666	674	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom4_AllChans_Ensembles_666 to 674.mat
6/21/2006	10:36:31 AM	Boom 5	797	805	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom5_AllChans_Ensembles_797 to 805.mat
6/21/2006	10:36:31 AM	Boom 6	961	969	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom6_AllChans_Ensembles_961 to 969.mat
6/21/2006	10:36:31 AM	Boom 7	1109	1117	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom7_AllChans_Ensembles_1109 to 1117.mat
6/21/2006	10:36:31 AM	Boom 8	1286	1294	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom8_AllChans_Ensembles_1286 to 1294.mat
6/21/2006	10:36:31 AM	Boom 9	1354	1362	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom9_AllChans_Ensembles_1354 to 1362.mat
6/21/2006	10:36:31 AM	Boom 10	1559	1567	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom10_AllChans_Ensembles_1559 to 1567.mat
6/21/2006	10:36:31 AM	Boom 11	1647	1655	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom11_AllChans_Ensembles_1647 to 1655.mat
6/21/2006	10:36:31 AM	Boom 12	1848	1856	9	25600	11.52	Run 6 21 2006 10 36 31 AM_Boom12_AllChans_Ensembles_1848 to 1856.mat
6/22/2006	9:25:30 AM	Boom 1	278	293	16	25600	20.48	Run 6 22 2006 9 25 30 AM_Boom1_AllChans_Ensembles_278 to 293.mat
6/22/2006	9:25:30 AM	Boom 2	319	334	16	25600	20.48	Run 6 22 2006 9 25 30 AM_Boom2_AllChans_Ensembles_319 to 334.mat
6/22/2006	9:25:30 AM	Boom 3	544	559	16	25600	20.48	Run 6 22 2006 9 25 30 AM_Boom3_AllChans_Ensembles_544 to 559.mat
6/22/2006	9:25:30 AM	Boom 4	612	627	16	25600	20.48	Run 6 22 2006 9 25 30 AM_Boom4_AllChans_Ensembles_612 to 627.mat
6/22/2006	9:39:45 AM	Boom 5	162	177	16	25600	20.48	Run 6 22 2006 9 39 45 AM_Boom5_AllChans_Ensembles_162 to 177.mat
6/22/2006	9:39:45 AM	Boom 6	287	272	16	25600	20.48	Run 6 22 2006 9 39 45 AM_Boom6_AllChans_Ensembles_257 to 272.mat
6/22/2006	9:39:45 AM	Boom 7	445	460	16	25600	20.48	Run 6 22 2006 9 39 45 AM_Boom7_AllChans_Ensembles_445 to 460.mat
6/22/2006	9:39:45 AM	Boom 8	561	576	16	25600	20.48	Run 6 22 2006 9 39 45 AM_Boom8_AllChans_Ensembles_561 to 576.mat
6/22/2006	9:39:45 AM	Boom 9	729	744	16	25600	20.48	Run 6 22 2006 9 39 45 AM_Boom9_AllChans_Ensembles_729 to 744.mat
6/22/2006	9:39:45 AM	Boom 10	862	877	16	25600	20.48	Run 6 22 2006 9 39 45 AM_Boom10_AllChans_Ensembles_862 to 877.mat
6/22/2006	10:00:04 AM	Boom 11	100	130	31	51200	19.84	Run 6 22 2006 10 00 04 AM_Boom11_AllChans_Ensembles_100 to 130.mat
6/22/2006	10:05:29 AM	Boom 12	39	54	16	25600	20.48	Run 6 22 2006 10 05 29 AM_Boom12_AllChans_Ensembles_39 to 54.mat
6/22/2006	10:05:29 AM	Boom 13	229	244	16	25600	20.48	Run 6 22 2006 10 05 29 AM_Boom13_AllChans_Ensembles_229 to 244.mat
6/22/2006	10:14:11 AM	Boom 14	108	138	31	51200	19.84	Run 6 22 2006 10 14 11 AM_Boom14_AllChans_Ensembles_108 to 138.mat

Table 6.2: Order of the int32 data written to the raw data files

Starting int32	Ending int32	Data
1	1	Number of channels in record
2	2	Number of samples per channel
$0*N_{\text{samp}}+3$	$1*N_{\text{samp}}+2$	Channel 1 time history data
$1*N_{\text{samp}}+3$	$2*N_{\text{samp}}+2$	Channel 2 time history data
$2*N_{\text{samp}}+3$	$3*N_{\text{samp}}+2$	Channel 3 time history data
\vdots	\vdots	\vdots
$(N-1)*N_{\text{samp}}+3$	$N*N_{\text{samp}}+2$	Channel N time history data

Where N_{samp} is the number of samples per channel.

Table 6.3: Description of all raw data collected.

Raw Data Date Stamp		Measurement Description	Excitation Type	Number of Events in Measurement	Samples per Ensemble	Sample Rate (Hz)	N number of Channels Recorded	Other Notes
6/13/2006	9:23:20 AM	Low amplitude booms	Sonic Boom	12	32,768	25600	288	Concurrent structural and subjective tests
6/13/2006	11:00:14 AM	Low amplitude booms	Sonic Boom	12	32,768	25600	288	Concurrent structural and subjective tests
6/15/2006	10:58:34 AM	Low amplitude booms	Sonic Boom	6	32,768	25600	288	Visitor day, no subjective tests this day
6/16/2006	9:29:18 AM	Low amplitude booms	Sonic Boom	8	32,768	25600	288	Trail plane dropped out after two booms
6/16/2006	11:03:41 AM	Low amplitude booms	Sonic Boom	12	32,768	25600	288	Concurrent structural and subjective tests
6/20/2006	9:52:28 AM	Low amplitude booms	Sonic Boom	12	32,768	25600	288	Concurrent structural and subjective tests
6/20/2006	11:11:31 AM	Low amplitude booms	Sonic Boom	12	32,768	25600	288	Concurrent structural and subjective tests
6/21/2006	9:26:11 AM	Low amplitude booms	Sonic Boom	12	32,768	25600	288	Concurrent structural and subjective tests
6/21/2006	10:56:31 AM	Low amplitude booms	Sonic Boom	12	32,768	25600	288	Concurrent structural and subjective tests
6/22/2006	9:25:30 AM	Normal amplitude booms	Sonic Boom	4	32,768	25600	288	No subjective tests this day
6/22/2006	9:39:45 AM	Normal amplitude booms	Sonic Boom	6	32,768	25600	288	No subjective tests this day
6/22/2006	10:00:04 AM	Normal amplitude booms	Sonic Boom	1	32,768	51200	288	No subjective tests this day
6/22/2006	10:05:29 AM	Normal amplitude booms	Sonic Boom	2	32,768	25600	288	No subjective tests this day
6/22/2006	10:14:11 AM	Normal amplitude booms	Sonic Boom	1	32,768	51200	288	No subjective tests this day
6/22/2006	11:42:15 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 190
6/22/2006	11:43:51 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 190
6/22/2006	11:44:28 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 190
6/22/2006	11:45:20 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 190
6/22/2006	11:46:05 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 190
6/22/2006	11:47:12 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 188
6/22/2006	11:47:50 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 188
6/22/2006	11:48:39 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 188
6/22/2006	11:49:57 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 203
6/22/2006	11:50:25 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 203
6/22/2006	11:51:10 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 203
6/22/2006	11:52:04 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop east of Microphone Array
6/22/2006	11:52:37 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop east of Microphone Array
6/22/2006	11:53:27 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 187
6/22/2006	11:54:26 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 187
6/22/2006	11:56:00 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 194
6/22/2006	11:56:36 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 194
6/22/2006	11:57:13 AM	Outside Bag Pop	Impulsive Acoustic	1	32,768	25600	288	One bag pop over Microphone 194
6/22/2006	12:07:07 PM	Front Bedroom Balloon Pop	Impulsive Acoustic	3	32,768	25600	288	Three pops near middle of room
6/22/2006	12:08:29 PM	Back Bedroom Balloon Pop	Impulsive Acoustic	3	32,768	25600	288	Three pops near middle of room
6/22/2006	12:11:05 PM	Equipment Room Balloon Pop	Impulsive Acoustic	3	32,768	25600	288	Three pops near middle of room
6/14/2006	12:10:17 PM	Subjective Room Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	No people in the chairs
6/14/2006	12:13:39 PM	Subjective Room Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	5 people seated in chairs
6/15/2006	10:11:14 AM	Subjective Room Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	12 people seated in chairs
6/14/2006	11:25:20 AM	Front Bedroom Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	Nominal foam configuration
6/20/2006	1:42:20 PM	Front Bedroom Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	Reduced foam configuration
6/14/2006	11:33:50 AM	Back Bedroom Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	Nominal foam configuration window closed
6/20/2006	2:36:47 PM	Back Bedroom Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	Nominal foam configuration window open
6/20/2006	1:51:13 PM	Back Bedroom Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	Increased foam configuration window closed
6/20/2006	2:27:52 PM	Back Bedroom Reverb Time	Band Limited Acoustic	63-5000 Hz Bands	32,768	12800	288	Increased foam configuration window open

Table continued on next page.

Table 6.3: Continued.

Raw Data Date Stamp	Measurement Description	Excitation Type	Number of Events in Measurement	Samples per Ensemble	Sample Rate (Hz)	Number of Channels Recorded	Other Notes
6/21/2006 4:06:34 PM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 1
6/21/2006 4:08:22 PM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 1
6/21/2006 4:10:10 PM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 1
6/21/2006 4:47:38 PM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 2
6/23/2006 6:29:38 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 2
6/23/2006 6:42:29 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 3
6/23/2006 6:46:09 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 3
6/23/2006 6:49:12 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 3
6/23/2006 8:03:59 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 4
6/23/2006 8:09:18 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 4
6/23/2006 8:35:07 AM	Window Rattle Test	30 Hz sine wave	1	8192	12800	288	Shaker attached at location 5
6/23/2006 8:38:19 AM	Window Rattle Test	30 Hz sine wave	1	8192	12800	288	Shaker attached at location 5
6/23/2006 8:39:58 AM	Window Rattle Test	30 Hz sine wave	1	8192	12800	288	Shaker attached at location 5
6/23/2006 8:41:15 AM	Window Rattle Test	30 Hz sine wave	1	8192	12800	288	Shaker attached at location 5
6/23/2006 8:45:44 AM	Window Rattle Test	pseudo-random	1	4096	1024	288	Shaker attached at location 5
6/23/2006 8:49:54 AM	Window Rattle Test	pseudo-random	1	16384	4096	288	Shaker attached at location 5
6/23/2006 8:52:56 AM	Window Rattle Test	pseudo-random	1	16384	4096	288	Shaker attached at location 5
6/23/2006 9:23:59 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 6
6/23/2006 9:21:11 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 6
6/23/2006 6:29:27 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 6
6/23/2006 10:00:51 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 7
6/23/2006 10:03:20 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 7
6/23/2006 10:26:57 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 8
6/23/2006 10:28:09 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 8
6/23/2006 10:31:06 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 8
6/23/2006 11:22:05 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 9
6/23/2006 11:24:33 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 9
6/23/2006 11:33:16 AM	Structural Shaker Test	pseudo-random	1	4096	4096	288	Shaker attached at location 10
6/23/2006 11:34:59 AM	Structural Shaker Test	pseudo-random	1	4096	1024	288	Shaker attached at location 10
3/29/2006 1:42:01 PM	Low amplitude booms	Sonic booms	N/A			56	Pretest low amplitude sonic booms
3/29/2006 5:16:21 PM	Wall Impact Tests	Impact hammer	N/A			56	Pretest wall impact tests
3/29/2006 5:23:02 PM	Window Impact Tests	Impact hammer	N/A			56	Pretest window impact tests
6/13/2006 12:30:15 PM	Microphone Calibration	123.39 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/13/2006 12:41:06 PM	Microphone Calibration	123.39 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/13/2006 6:22:20 AM	Microphone Calibration	123.39 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/14/2006 6:57:09 AM	Microphone Calibration	123.40 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/14/2006 7:18:48 AM	Microphone Calibration	123.40 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/15/2006 7:10:18 AM	Microphone Calibration	123.35 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/16/2006 12:04:31 PM	Microphone Calibration	123.39 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/16/2006 7:00:29 AM	Microphone Calibration	123.39 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/20/2006 12:57:36 PM	Microphone Calibration	123.36 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/20/2006 6:45:58 AM	Microphone Calibration	123.36 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/20/2006 8:12:52 AM	Microphone Calibration	123.36 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/21/2006 2:09:56 PM	Microphone Calibration	123.36 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/21/2006 7:02:00 AM	Microphone Calibration	123.36 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/22/2006 10:38:50 AM	Microphone Calibration	123.39 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones
6/22/2006 8:42:27 AM	Microphone Calibration	123.39 dB at 250 Hz	Individual Mk Cals	32,768	3200	288	Calibration of the precision microphones

Table 6.4: Location of the front shock measured at Channel 190 in the Matlab data sets.

Matlab Data File	Sample Corresponding to Arrival of Front Shock at Channel 190	Sample Rate (Hz)	Time From Start of Record to Arrival of Front Shock (sec)
Run 6_13_200611_00_14 AM_Boom1_AllCh_Ensembles_300 to 308.mat	30092	25600	1.17547
Run 6_13_200611_00_14 AM_Boom2_AllCh_Ensembles_396 to 404.mat	53524	25600	2.09078
Run 6_13_200611_00_14 AM_Boom3_AllCh_Ensembles_618 to 629.mat	77989	25600	3.04645
Run 6_13_200611_00_14 AM_Boom4_AllCh_Ensembles_735 to 743.mat	50427	25600	1.96980
Run 6_13_200611_00_14 AM_Boom5_AllCh_Ensembles_906 to 914.mat	28027	25600	1.09480
Run 6_13_200611_00_14 AM_Boom6_AllCh_Ensembles_1028 to 1036.mat	35769	25600	1.39723
Run 6_13_200611_00_14 AM_Boom7_AllCh_Ensembles_1211 to 1219.mat	53008	25600	2.07063
Run 6_13_200611_00_14 AM_Boom8_AllCh_Ensembles_1363 to 1371.mat	27202	25600	1.06258
Run 6_13_200611_00_14 AM_Boom9_AllCh_Ensembles_1485 to 1493.mat	21834	25600	0.85289
Run 6_13_200611_00_14 AM_Boom10_AllCh_Ensembles_1608 to 1616.mat	29576	25600	1.15531
Run 6_13_200611_00_14 AM_Boom11_AllCh_Ensembles_1790 to 1798.mat	32466	25600	1.26820
Run 6_13_200611_00_14 AM_Boom12_AllCh_Ensembles_1873 to 1881.mat	38866	25600	1.51820
Run 6_13_20069_23_20 AM_Boom1_AllCh_Ensembles_373 to 381.mat	44234	25600	1.72789
Run 6_13_20069_23_20 AM_Boom2_AllCh_Ensembles_541 to 549.mat	39382	25600	1.53836
Run 6_13_20069_23_20 AM_Boom3_AllCh_Ensembles_659 to 667.mat	38969	25600	1.52223
Run 6_13_20069_23_20 AM_Boom4_AllCh_Ensembles_805 to 813.mat	22660	25600	0.88516
Run 6_13_20069_23_20 AM_Boom5_AllCh_Ensembles_947 to 955.mat	31537	25600	1.23191
Run 6_13_20069_23_20 AM_Boom6_AllCh_Ensembles_1135 to 1143.mat	20492	25600	0.80047
Run 6_13_20069_23_20 AM_Boom7_AllCh_Ensembles_1230 to 1238.mat	37008	25600	1.44563
Run 6_13_20069_23_20 AM_Boom8_AllCh_Ensembles_1413 to 1421.mat	38763	25600	1.51418
Run 6_13_20069_23_20 AM_Boom9_AllCh_Ensembles_1537 to 1545.mat	39485	25600	1.54238
Run 6_13_20069_23_20 AM_Boom10_AllCh_Ensembles_1679 to 1687.mat	40208	25600	1.57063
Run 6_13_20069_23_20 AM_Boom11_AllCh_Ensembles_1820 to 1828.mat	31331	25600	1.22387
Run 6_13_20069_23_20 AM_Boom12_AllCh_Ensembles_1959 to 1967.mat	22453	25600	0.87707
Run 6_15_200610_58_34 AM_Boom1_AllCh_Ensembles_152 to 160.mat	43305	25600	1.69160
Run 6_15_200610_58_34 AM_Boom2_AllCh_Ensembles_473 to 481.mat	19356	25600	0.75609
Run 6_15_200610_58_34 AM_Boom3_AllCh_Ensembles_745 to 753.mat	30711	25600	1.19965
Run 6_15_200610_58_34 AM_Boom4_AllCh_Ensembles_1001 to 1009.mat	42892	25600	1.67547
Run 6_15_200610_58_34 AM_Boom5_AllCh_Ensembles_1258 to 1266.mat	34427	25600	1.34480
Run 6_15_200610_58_34 AM_Boom6_AllCh_Ensembles_1461 to 1469.mat	38660	25600	1.51016
Run 6_16_200611_03_41 AM_Boom1_AllCh_Ensembles_372 to 380.mat	37318	25600	1.45773
Run 6_16_200611_03_41 AM_Boom2_AllCh_Ensembles_504 to 512.mat	31847	25600	1.24402
Run 6_16_200611_03_41 AM_Boom3_AllCh_Ensembles_674 to 682.mat	30402	25600	1.18758
Run 6_16_200611_03_41 AM_Boom4_AllCh_Ensembles_807 to 815.mat	30505	25600	1.19160
Run 6_16_200611_03_41 AM_Boom5_AllCh_Ensembles_932 to 940.mat	20905	25600	0.81660
Run 6_16_200611_03_41 AM_Boom6_AllCh_Ensembles_1089 to 1097.mat	45576	25600	1.78031
Run 6_16_200611_03_41 AM_Boom7_AllCh_Ensembles_1227 to 1235.mat	47950	25600	1.87305
Run 6_16_200611_03_41 AM_Boom8_AllCh_Ensembles_1358 to 1366.mat	32260	25600	1.26016
Run 6_16_200611_03_41 AM_Boom9_AllCh_Ensembles_1513 to 1521.mat	16363	25600	0.63918
Run 6_16_200611_03_41 AM_Boom10_AllCh_Ensembles_1640 to 1648.mat	26892	25600	1.05047
Run 6_16_200611_03_41 AM_Boom11_AllCh_Ensembles_1756 to 1764.mat	23589	25600	0.92145
Run 6_16_200611_03_41 AM_Boom12_AllCh_Ensembles_1911 to 1919.mat	22866	25600	0.89320
Run 6_16_20069_29_18 AM_Boom1_AllCh_Ensembles_149 to 157.mat	15537	25600	0.60691
Run 6_16_20069_29_18 AM_Boom2_AllCh_Ensembles_243 to 251.mat	39485	25600	1.54238
Run 6_16_20069_29_18 AM_Boom3_AllCh_Ensembles_473 to 481.mat	36698	25600	1.43352
Run 6_16_20069_29_18 AM_Boom4_AllCh_Ensembles_559 to 567.mat	26169	25600	1.02223
Run 6_16_20069_29_18 AM_Boom5_AllCh_Ensembles_775 to 783.mat	21937	25600	0.85691
Run 6_16_20069_29_18 AM_Boom7_AllCh_Ensembles_1032 to 1040.mat	47847	25600	1.86902
Run 6_16_20069_29_18 AM_Boom9_AllCh_Ensembles_1232 to 1240.mat	17705	25600	0.69160
Run 6_16_20069_29_18 AM_Boom11_AllCh_Ensembles_1448 to 1456.mat	18014	25600	0.70367
Run 6_20_200611_11_31 AM_Boom1_AllCh_Ensembles_274 to 282.mat	48156	25600	1.88109
Run 6_20_200611_11_31 AM_Boom2_AllCh_Ensembles_376 to 384.mat	43614	25600	1.70367
Run 6_20_200611_11_31 AM_Boom3_AllCh_Ensembles_571 to 579.mat	21111	25600	0.82465
Run 6_20_200611_11_31 AM_Boom4_AllCh_Ensembles_702 to 710.mat	24724	25600	0.96578
Run 6_20_200611_11_31 AM_Boom5_AllCh_Ensembles_824 to 832.mat	41653	25600	1.62707
Run 6_20_200611_11_31 AM_Boom6_AllCh_Ensembles_990 to 998.mat	18118	25600	0.70773
Run 6_20_200611_11_31 AM_Boom7_AllCh_Ensembles_1142 to 1150.mat	23589	25600	0.92145
Run 6_20_200611_11_31 AM_Boom8_AllCh_Ensembles_1279 to 1287.mat	16879	25600	0.65934
Run 6_20_200611_11_31 AM_Boom9_AllCh_Ensembles_1390 to 1398.mat	24518	25600	0.95773
Run 6_20_200611_11_31 AM_Boom10_AllCh_Ensembles_1609 to 1617.mat	17602	25600	0.68758
Run 6_20_200611_11_31 AM_Boom11_AllCh_Ensembles_1738 to 1746.mat	32156	25600	1.25609
Run 6_20_200611_11_31 AM_Boom12_AllCh_Ensembles_1888 to 1896.mat	19356	25600	0.75609
Run 6_20_20069_52_28 AM_Boom1_AllCh_Ensembles_88 to 96.mat	26066	25600	1.01820
Run 6_20_20069_52_28 AM_Boom2_AllCh_Ensembles_250 to 258.mat	29369	25600	1.14723

Table continued on next page.

Table 6.4: Concluded.

Matlab Data File	Sample Corresponding to Arrival of Front Shock at Channel 190	Sample Rate (Hz)	Time From Start of Record to Arrival of Front Shock (sec)
Run 6_20_2006 9_52_28 AM_Boom3_AllCh_Ensembles_399 to 407.mat	48053	25600	1.87707
Run 6_20_2006 9_52_28 AM_Boom4_AllCh_Ensembles_522 to 530.mat	50221	25600	1.96176
Run 6_20_2006 9_52_28 AM_Boom5_AllCh_Ensembles_658 to 666.mat	24311	25600	0.94965
Run 6_20_2006 9_52_28 AM_Boom6_AllCh_Ensembles_760 to 768.mat	26272	25600	1.02625
Run 6_20_2006 9_52_28 AM_Boom7_AllCh_Ensembles_925 to 933.mat	21318	25600	0.83273
Run 6_20_2006 9_52_28 AM_Boom8_AllCh_Ensembles_1059 to 1067.mat	40414	25600	1.57867
Run 6_20_2006 9_52_28 AM_Boom9_AllCh_Ensembles_1139 to 1147.mat	32879	25600	1.28434
Run 6_20_2006 9_52_28 AM_Boom10_AllCh_Ensembles_1298 to 1306.mat	41550	25600	1.62305
Run 6_20_2006 9_52_28 AM_Boom11_AllCh_Ensembles_1443 to 1451.mat	25137	25600	0.98191
Run 6_20_2006 9_52_28 AM_Boom12_AllCh_Ensembles_1585 to 1593.mat	24518	25600	0.95773
Run 6_21_2006 10_56_31 AM_Boom1_AllCh_Ensembles_232 to 240.mat	45679	25600	1.78434
Run 6_21_2006 10_56_31 AM_Boom2_AllCh_Ensembles_341 to 349.mat	26376	25600	1.03031
Run 6_21_2006 10_56_31 AM_Boom3_AllCh_Ensembles_545 to 553.mat	32982	25600	1.28836
Run 6_21_2006 10_56_31 AM_Boom4_AllCh_Ensembles_666 to 674.mat	27821	25600	1.08676
Run 6_21_2006 10_56_31 AM_Boom5_AllCh_Ensembles_797 to 805.mat	48156	25600	1.88109
Run 6_21_2006 10_56_31 AM_Boom6_AllCh_Ensembles_961 to 969.mat	27408	25600	1.07063
Run 6_21_2006 10_56_31 AM_Boom7_AllCh_Ensembles_1109 to 1117.mat	24001	25600	0.93754
Run 6_21_2006 10_56_31 AM_Boom8_AllCh_Ensembles_1286 to 1294.mat	21731	25600	0.84887
Run 6_21_2006 10_56_31 AM_Boom9_AllCh_Ensembles_1354 to 1362.mat	44337	25600	1.73191
Run 6_21_2006 10_56_31 AM_Boom10_AllCh_Ensembles_1559 to 1567.mat	20285	25600	0.79238
Run 6_21_2006 10_56_31 AM_Boom11_AllCh_Ensembles_1647 to 1655.mat	29163	25600	1.13918
Run 6_21_2006 10_56_31 AM_Boom12_AllCh_Ensembles_1848 to 1856.mat	23485	25600	0.91738
Run 6_21_2006 9_26_11 AM_Boom1_AllCh_Ensembles_238 to 246.mat	29679	25600	1.15934
Run 6_21_2006 9_26_11 AM_Boom2_AllCh_Ensembles_387 to 395.mat	42066	25600	1.64320
Run 6_21_2006 9_26_11 AM_Boom3_AllCh_Ensembles_560 to 568.mat	27408	25600	1.07063
Run 6_21_2006 9_26_11 AM_Boom4_AllCh_Ensembles_714 to 722.mat	17085	25600	0.66738
Run 6_21_2006 9_26_11 AM_Boom5_AllCh_Ensembles_808 to 816.mat	40311	25600	1.57465
Run 6_21_2006 9_26_11 AM_Boom6_AllCh_Ensembles_960 to 968.mat	36285	25600	1.41738
Run 6_21_2006 9_26_11 AM_Boom7_AllCh_Ensembles_1118 to 1126.mat	24105	25600	0.94160
Run 6_21_2006 9_26_11 AM_Boom8_AllCh_Ensembles_1235 to 1243.mat	23485	25600	0.91738
Run 6_21_2006 9_26_11 AM_Boom9_AllCh_Ensembles_1376 to 1384.mat	39072	25600	1.52625
Run 6_21_2006 9_26_11 AM_Boom10_AllCh_Ensembles_1556 to 1564.mat	18840	25600	0.73594
Run 6_21_2006 9_26_11 AM_Boom11_AllCh_Ensembles_1680 to 1688.mat	45472	25600	1.77625
Run 6_21_2006 9_26_11 AM_Boom12_AllCh_Ensembles_1816 to 1824.mat	43614	25600	1.70367
Run 6_22_2006 9_25_30 AM_Boom1_AllCh_Ensembles_278 to 293.mat	21731	25600	0.84887
Run 6_22_2006 9_25_30 AM_Boom2_AllCh_Ensembles_319 to 334.mat	51253	25600	2.00207
Run 6_22_2006 9_25_30 AM_Boom3_AllCh_Ensembles_544 to 559.mat	51666	25600	2.01820
Run 6_22_2006 9_25_30 AM_Boom4_AllCh_Ensembles_612 to 627.mat	97189	25600	3.79645
Run 6_22_2006 9_39_45 AM_Boom5_AllCh_Ensembles_162 to 177.mat	50531	25600	1.97387
Run 6_22_2006 9_39_45 AM_Boom6_AllCh_Ensembles_257 to 272.mat	38763	25600	1.51418
Run 6_22_2006 9_39_45 AM_Boom7_AllCh_Ensembles_445 to 460.mat	46505	25600	1.81660
Run 6_22_2006 9_39_45 AM_Boom8_AllCh_Ensembles_561 to 576.mat	36285	25600	1.41738
Run 6_22_2006 9_39_45 AM_Boom9_AllCh_Ensembles_729 to 744.mat	41653	25600	1.62707
Run 6_22_2006 9_39_45 AM_Boom10_AllCh_Ensembles_862 to 877.mat	88621	25600	3.46176
Run 6_22_2006 10_00_04 AM_Boom11_AllCh_Ensembles_100 to 130.mat	67821	51200	1.32463
Run 6_22_2006 10_05_29 AM_Boom12_AllCh_Ensembles_39 to 54.mat	36285*	25600	1.41738
Run 6_22_2006 10_05_29 AM_Boom13_AllCh_Ensembles_229 to 244.mat	50427*	25600	1.96980
Run 6_22_2006 10_14_11 AM_Boom14_AllCh_Ensembles_108 to 138.mat	95279*	51200	1.86092

* These correspond to the initial rise of microphone 187, since these booms had a west to east heading instead of the normal east to west heading.

Table 6.5: Peak overpressures recorded by the microphone attached to Channel 194 for each sonic boom

Date	Session Start Time	Boom Number	Ch 194 Peak Pressure lb _f /ft ²	Ch 194 Sensitivity mV/Pa	Date	Session Start Time	Boom Number	Ch 194 Peak Pressure lb _f /ft ²	Ch 194 Sensitivity mV/Pa
6/13/2006	9:23:20 AM	Boom 1	0.40	-41.6	6/20/2006	9:52:28 AM	Boom 7	0.11	-131
6/13/2006	9:23:20 AM	Boom 2	0.09	-41.6	6/20/2006	9:52:28 AM	Boom 8	0.22	-131
6/13/2006	9:23:20 AM	Boom 3	0.16	-41.6	6/20/2006	9:52:28 AM	Boom 9	0.80	-131
6/13/2006	9:23:20 AM	Boom 4	0.51	-41.6	6/20/2006	9:52:28 AM	Boom 10	0.30	-131
6/13/2006	9:23:20 AM	Boom 5	0.15	-41.6	6/20/2006	9:52:28 AM	Boom 11	0.46	-131
6/13/2006	9:23:20 AM	Boom 6	0.19	-41.6	6/20/2006	9:52:28 AM	Boom 12	0.34	-131
6/13/2006	9:23:20 AM	Boom 7	0.09	-41.6	6/20/2006	11:11:31 AM	Boom 1	0.65	-131.3
6/13/2006	9:23:20 AM	Boom 8	0.12	-41.6	6/20/2006	11:11:31 AM	Boom 2	0.27	-131.3
6/13/2006	9:23:20 AM	Boom 9	0.12	-41.6	6/20/2006	11:11:31 AM	Boom 3	0.21	-131.3
6/13/2006	9:23:20 AM	Boom 10	0.04	-41.6	6/20/2006	11:11:31 AM	Boom 4	0.33	-131.3
6/13/2006	9:23:20 AM	Boom 11	0.08	-41.6	6/20/2006	11:11:31 AM	Boom 5	0.50	-131.3
6/13/2006	9:23:20 AM	Boom 12	0.62	-41.6	6/20/2006	11:11:31 AM	Boom 6	0.26	-131.3
6/13/2006	11:00:14 AM	Boom 1	0.34	-41.5	6/20/2006	11:11:31 AM	Boom 7	0.20	-131.3
6/13/2006	11:00:14 AM	Boom 2	0.07	-41.5	6/20/2006	11:11:31 AM	Boom 8	0.71	-131.3
6/13/2006	11:00:14 AM	Boom 3	0.18	-41.5	6/20/2006	11:11:31 AM	Boom 9	0.29	-131.3
6/13/2006	11:00:14 AM	Boom 4	0.19	-41.5	6/20/2006	11:11:31 AM	Boom 10	0.15	-131.3
6/13/2006	11:00:14 AM	Boom 5	0.05	-41.5	6/20/2006	11:11:31 AM	Boom 11	0.27	-131.3
6/13/2006	11:00:14 AM	Boom 6	0.17	-41.5	6/20/2006	11:11:31 AM	Boom 12	0.39	-131.3
6/13/2006	11:00:14 AM	Boom 7	0.08	-41.5	6/21/2006	9:26:11 AM	Boom 1	0.56	-131.6
6/13/2006	11:00:14 AM	Boom 8	0.09	-41.5	6/21/2006	9:26:11 AM	Boom 2	0.22	-131.6
6/13/2006	11:00:14 AM	Boom 9	0.37	-41.5	6/21/2006	9:26:11 AM	Boom 3	0.39	-131.6
6/13/2006	11:00:14 AM	Boom 10	0.18	-41.5	6/21/2006	9:26:11 AM	Boom 4	0.22	-131.6
6/13/2006	11:00:14 AM	Boom 11	0.05	-41.5	6/21/2006	9:26:11 AM	Boom 5	0.52	-131.6
6/13/2006	11:00:14 AM	Boom 12	0.41	-41.5	6/21/2006	9:26:11 AM	Boom 6	0.28	-131.6
6/15/2006	10:58:34 AM	Boom 1	0.21	-133.23	6/21/2006	9:26:11 AM	Boom 7	0.29	-131.6
6/15/2006	10:58:34 AM	Boom 2	0.08	-133.23	6/21/2006	9:26:11 AM	Boom 8	0.28	-131.6
6/15/2006	10:58:34 AM	Boom 3	0.04	-133.23	6/21/2006	9:26:11 AM	Boom 9	0.51	-131.6
6/15/2006	10:58:34 AM	Boom 4	0.07	-133.23	6/21/2006	9:26:11 AM	Boom 10	0.25	-131.6
6/15/2006	10:58:34 AM	Boom 5	0.11	-133.23	6/21/2006	9:26:11 AM	Boom 11	0.19	-131.6
6/15/2006	10:58:34 AM	Boom 6	0.14	-133.23	6/21/2006	9:26:11 AM	Boom 12	0.24	-131.6
6/16/2006	9:29:18 AM	Boom 1	0.47	-41.5	6/21/2006	10:56:31 AM	Boom 1	0.51	-132
6/16/2006	9:29:18 AM	Boom 2	0.48	-41.5	6/21/2006	10:56:31 AM	Boom 2	0.36	-132
6/16/2006	9:29:18 AM	Boom 3	0.30	-41.5	6/21/2006	10:56:31 AM	Boom 3	0.25	-132
6/16/2006	9:29:18 AM	Boom 4	0.73	-41.5	6/21/2006	10:56:31 AM	Boom 4	0.20	-132
6/16/2006	9:29:18 AM	Boom 5	0.16	-41.5	6/21/2006	10:56:31 AM	Boom 5	0.48	-132
6/16/2006	9:29:18 AM	Boom 7	0.42	-41.5	6/21/2006	10:56:31 AM	Boom 6	0.70	-132
6/16/2006	9:29:18 AM	Boom 9	0.54	-41.5	6/21/2006	10:56:31 AM	Boom 7	0.38	-132
6/16/2006	9:29:18 AM	Boom 11	0.41	-41.5	6/21/2006	10:56:31 AM	Boom 8	0.41	-132
6/16/2006	11:03:41 AM	Boom 1	0.61	-41.5	6/21/2006	10:56:31 AM	Boom 9	0.50	-132
6/16/2006	11:03:41 AM	Boom 2	0.22	-41.5	6/21/2006	10:56:31 AM	Boom 10	0.39	-132
6/16/2006	11:03:41 AM	Boom 3	0.60	-41.5	6/21/2006	10:56:31 AM	Boom 11	0.41	-132
6/16/2006	11:03:41 AM	Boom 4	0.24	-41.5	6/21/2006	10:56:31 AM	Boom 12	0.24	-132
6/16/2006	11:03:41 AM	Boom 5	0.54	-41.5	6/22/2006	9:25:30 AM	Boom 1	1.28	-41
6/16/2006	11:03:41 AM	Boom 6	0.56	-41.5	6/22/2006	9:25:30 AM	Boom 2	1.66	-41
6/16/2006	11:03:41 AM	Boom 7	0.18	-41.5	6/22/2006	9:25:30 AM	Boom 3	0.84	-41
6/16/2006	11:03:41 AM	Boom 8	0.19	-41.5	6/22/2006	9:25:30 AM	Boom 4	0.94	-41
6/16/2006	11:03:41 AM	Boom 9	0.22	-41.5	6/22/2006	9:39:45 AM	Boom 5	1.10	-41
6/16/2006	11:03:41 AM	Boom 10	0.35	-41.5	6/22/2006	9:39:45 AM	Boom 6	1.08	-41
6/16/2006	11:03:41 AM	Boom 11	0.36	-41.5	6/22/2006	9:39:45 AM	Boom 7	1.83	-41
6/16/2006	11:03:41 AM	Boom 12	0.25	-41.5	6/22/2006	9:39:45 AM	Boom 8	1.21	-41
6/20/2006	9:52:28 AM	Boom 1	0.41	-131	6/22/2006	9:39:45 AM	Boom 9	1.43	-41
6/20/2006	9:52:28 AM	Boom 2	0.30	-131	6/22/2006	9:39:45 AM	Boom 10	1.24	-41
6/20/2006	9:52:28 AM	Boom 3	0.22	-131	6/22/2006	10:00:04 AM	Boom 11	1.83	-41
6/20/2006	9:52:28 AM	Boom 4	0.19	-131	6/22/2006	10:05:29 AM	Boom 12	1.23	-41
6/20/2006	9:52:28 AM	Boom 5	0.20	-131	6/22/2006	10:05:29 AM	Boom 13	1.50	-41
6/20/2006	9:52:28 AM	Boom 6	0.41	-131	6/22/2006	10:14:11 AM	Boom 14	1.39	-41

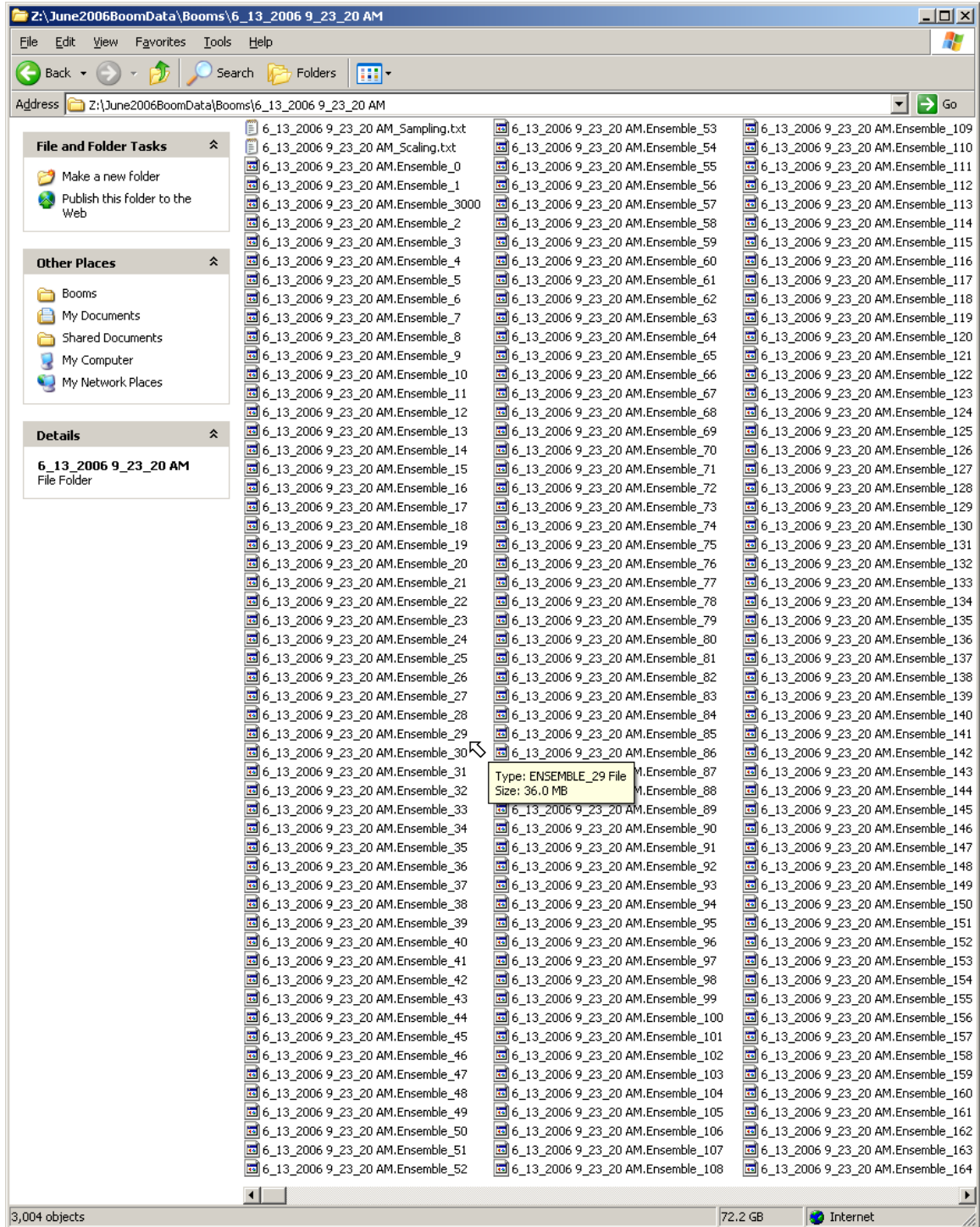


Figure 6.1: Illustration of some of the raw data files written during the 9:23:20 AM measurement session on June 13th, 2006.

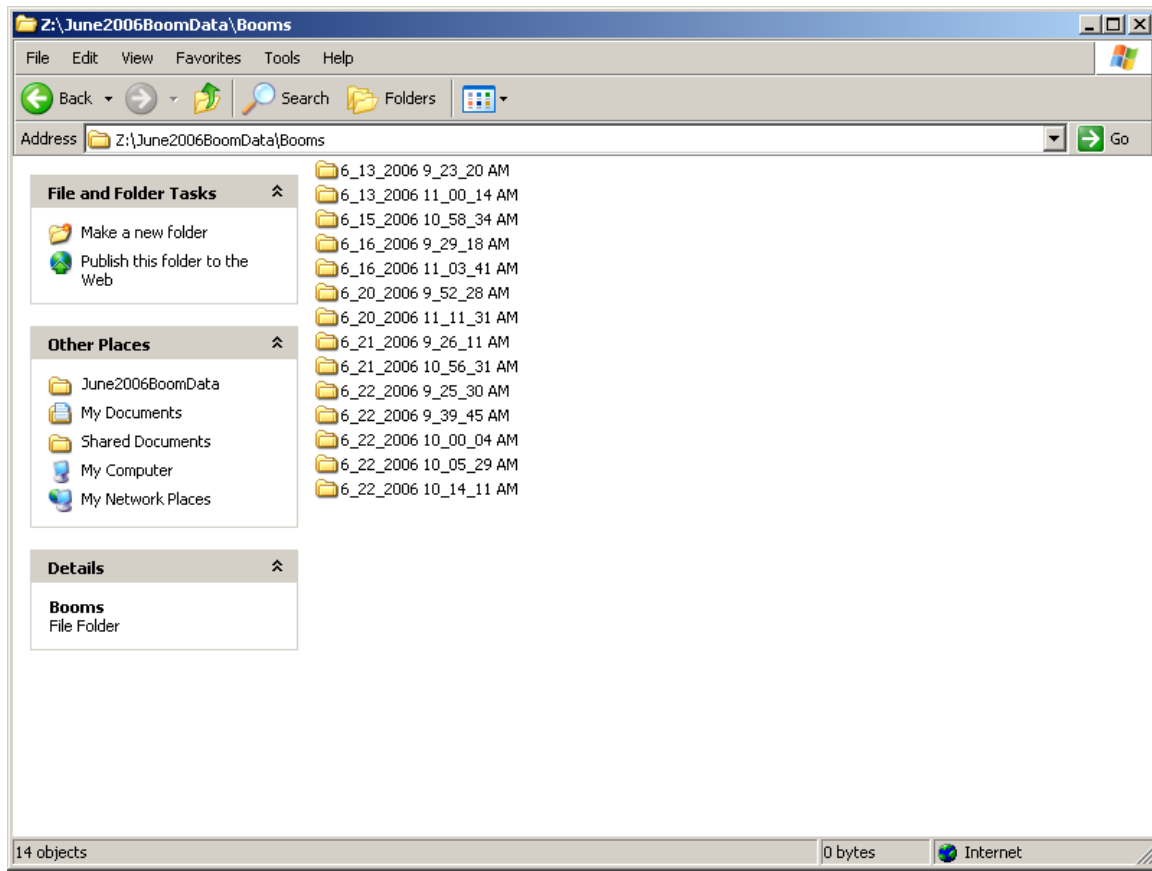


Figure 6.2: Root directory structure of the boom measurement raw data files.

Run 6_22_2006 9_39_45 AM_Boom6_AllChans_Ensembles_257 to 272.mat

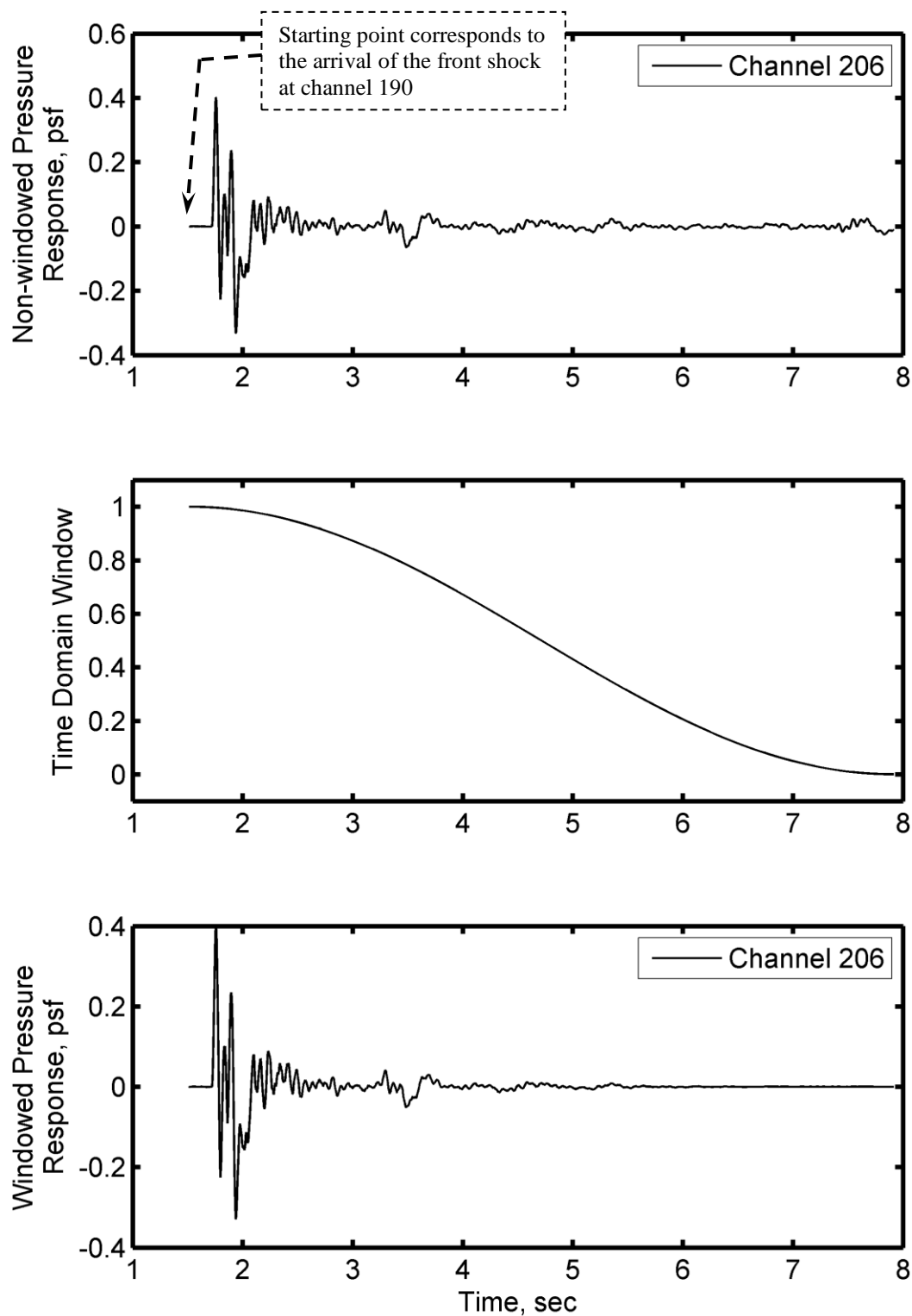


Figure 6.3: Example of the windowing of a time history of an indoor microphone prior to computing the spectrum of the signal. Note that the front shock arrived at channel 190 1.51 seconds into this reduced data record (Table 6.4).

Run 6_22_2006 9_39_45 AM_Boom6_AllChans_Ensembles_257 to 272.mat

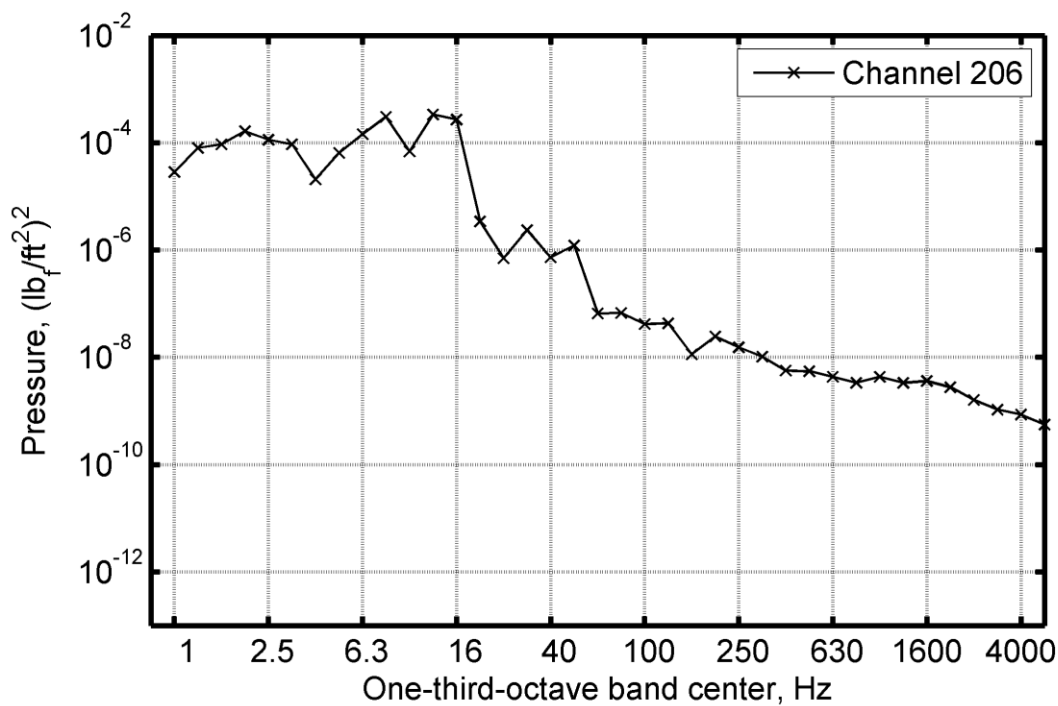
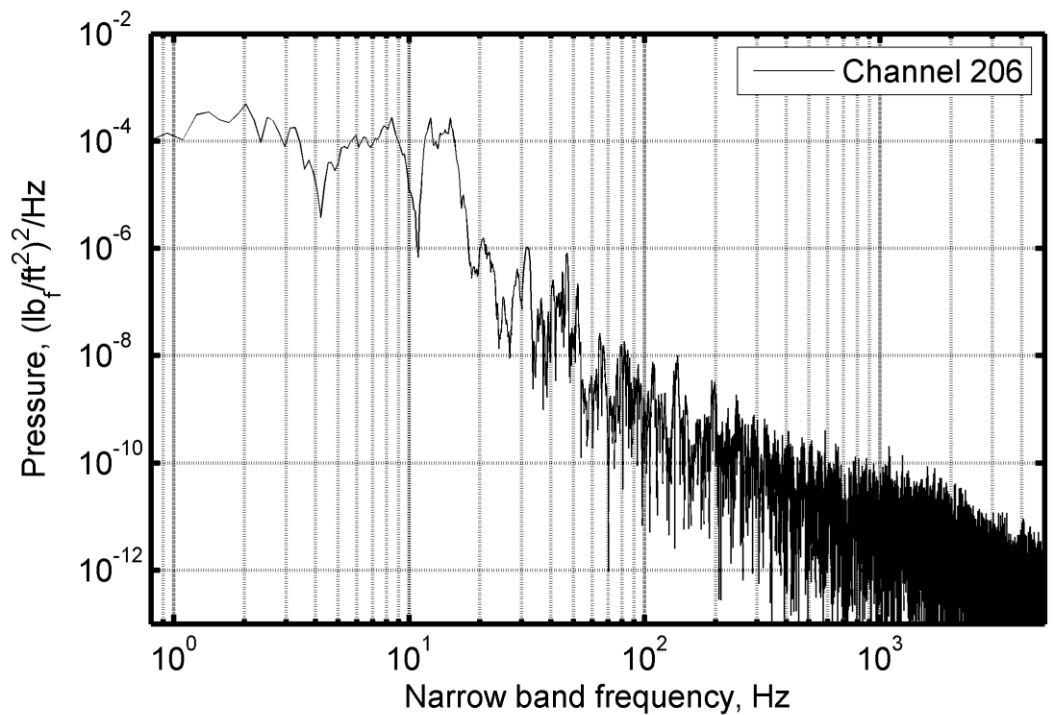


Figure 6.4: Example narrow band and one-third-octave band spectrum for channel 206 (an indoor microphone) computed from the windowed time history.

Run 6_20_2006 11_11_31 AM_Boom7_AllChans_Ensembles_1142 to 1150.ma

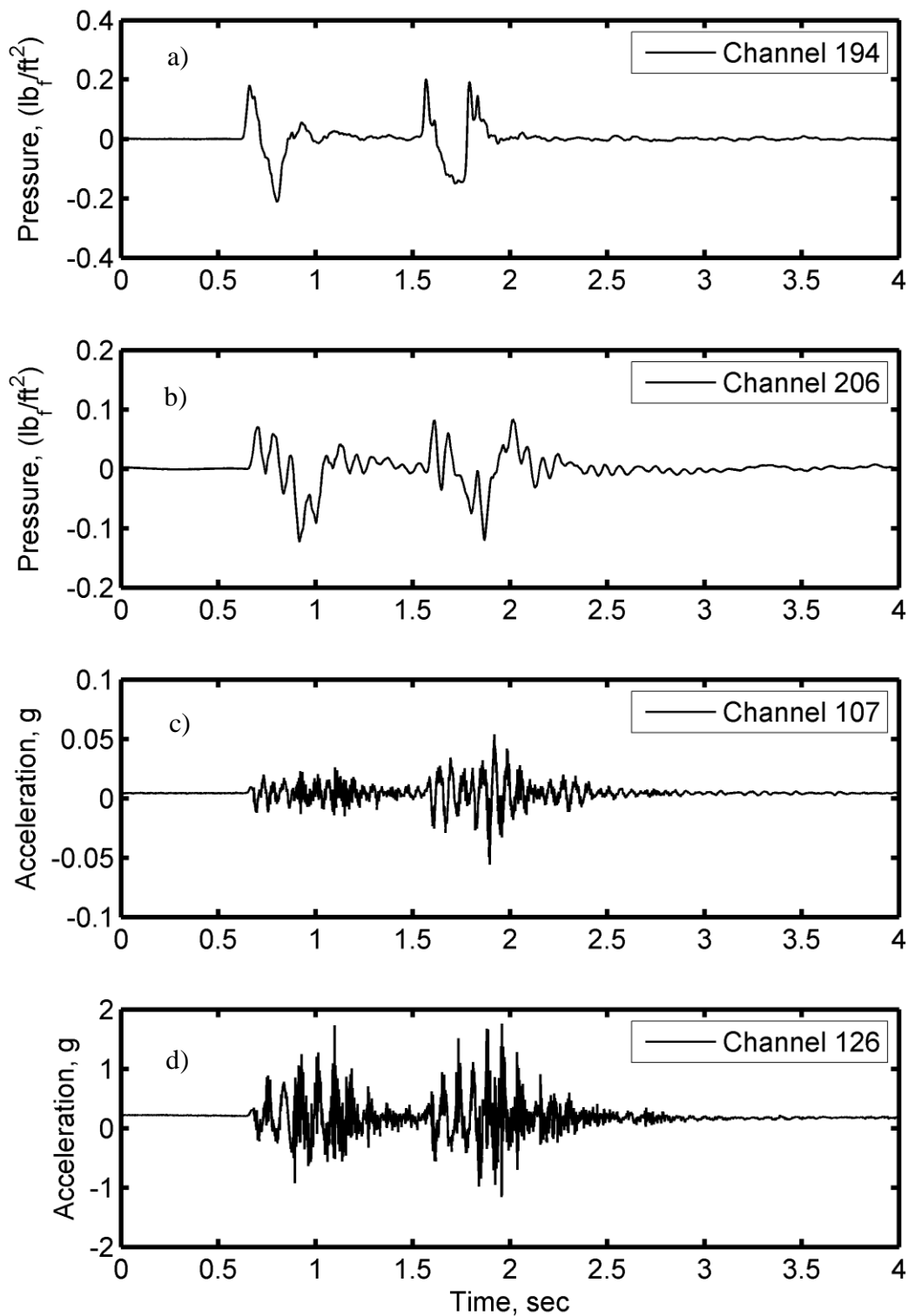


Figure 6.5: Time histories of four transducer responses for a low amplitude sonic boom; a) an outdoor microphone, b) an indoor microphone, c) a wall-mounted accelerometer, and d) a window-mounted accelerometer are shown.

Run 6_22_2006 9_39_45 AM_Boom6_AllChans_Ensembles_257 to 272.mat

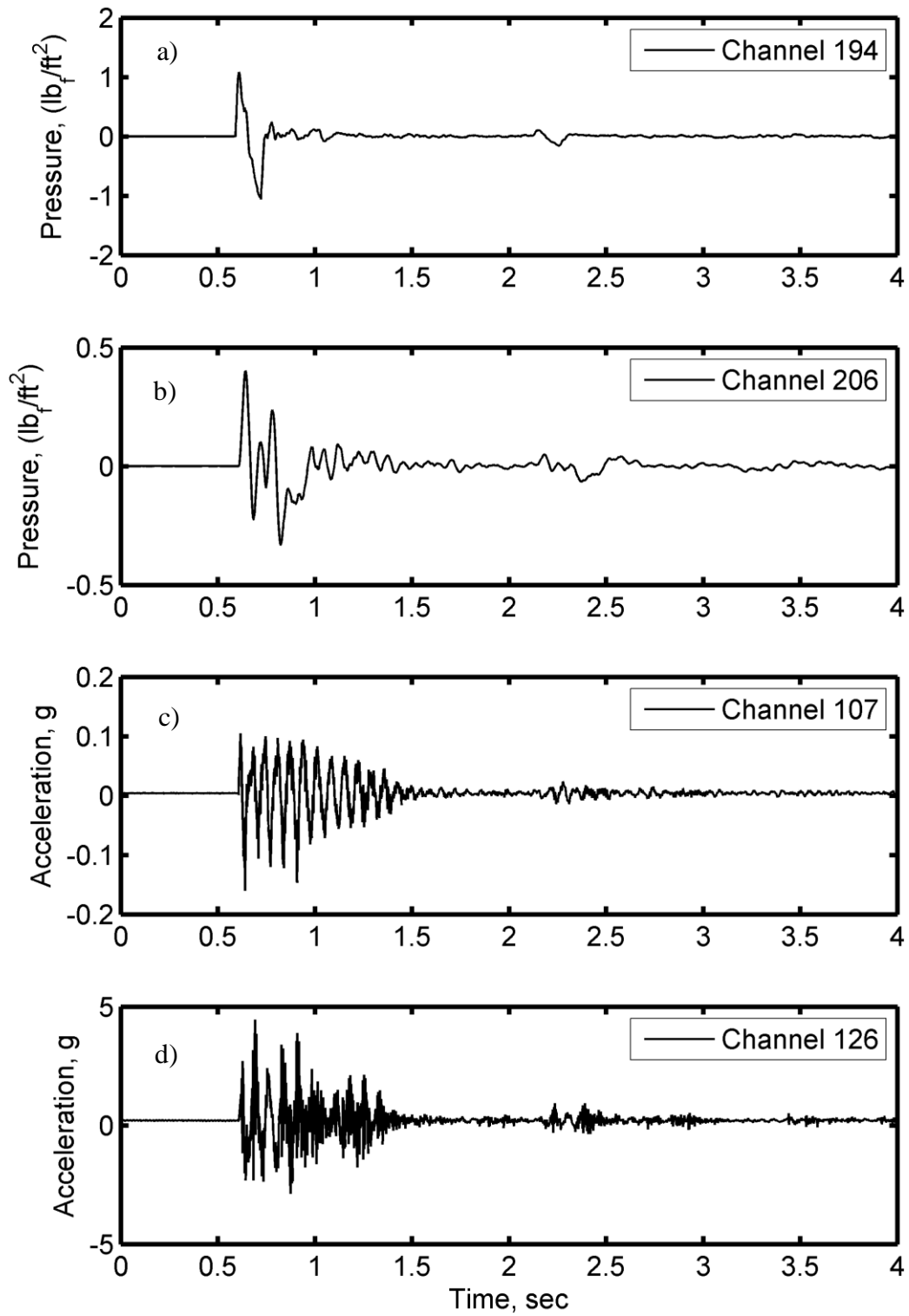


Figure 6.6: Time histories of four transducer responses for a normal amplitude sonic boom; a) an outdoor microphone, b) an indoor microphone, c) a wall-mounted accelerometer, and d) a window-mounted accelerometer are shown.

Run 6_20_2006 11_11_31 AM_Boom7_AllChans_Ensembles_1142 to 1150.ma

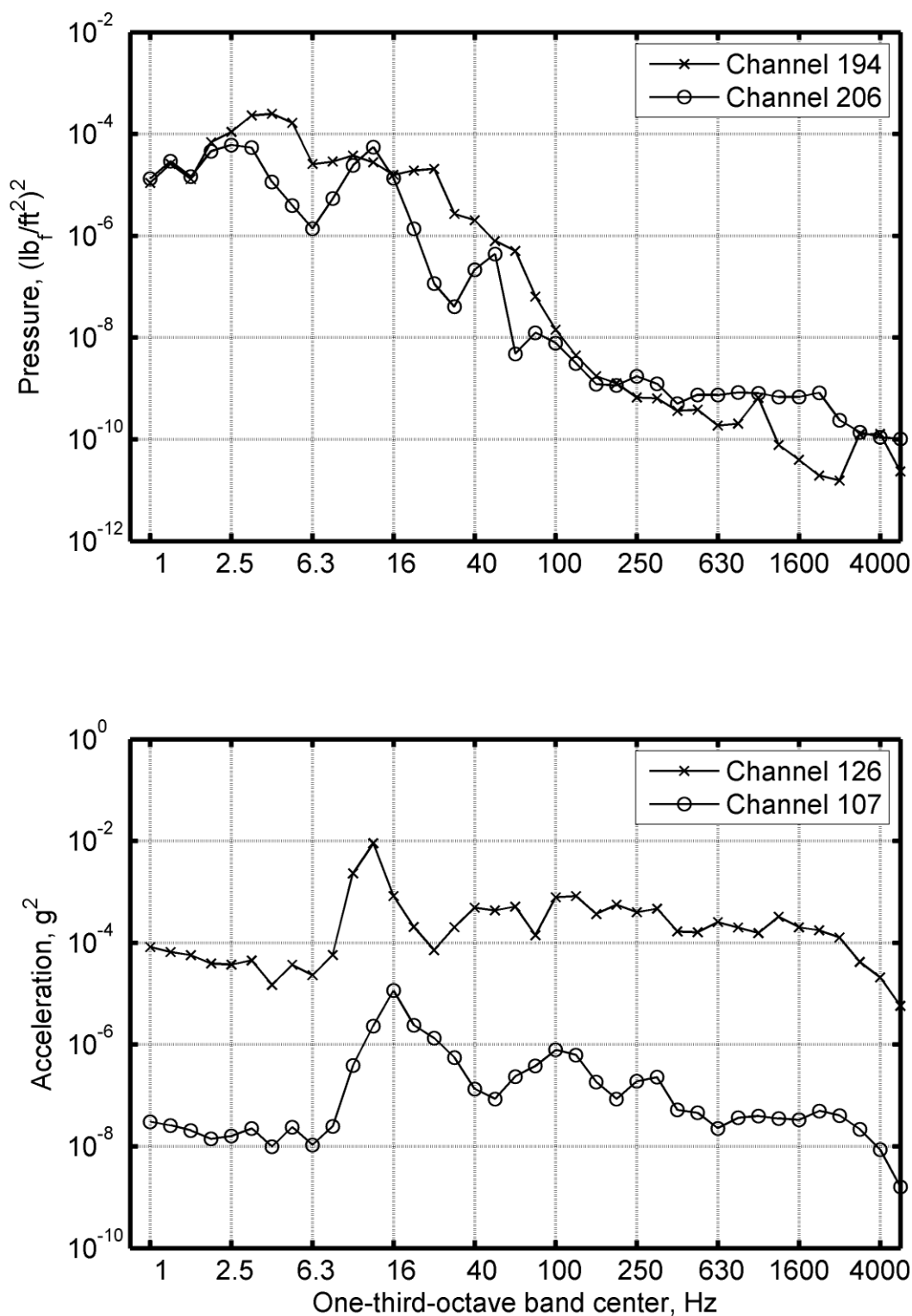


Figure 6.7: Spectra of four transducer responses for a low amplitude sonic boom; ch. 194 is an outdoor microphone, ch. 206 is an indoor microphone, ch. 107 is a wall-mounted accelerometer, and ch. 126 is a window-mounted accelerometer.

Run 6_22_2006 9_39_45 AM_Boom6_AllChans_Ensembles_257 to 272.mat

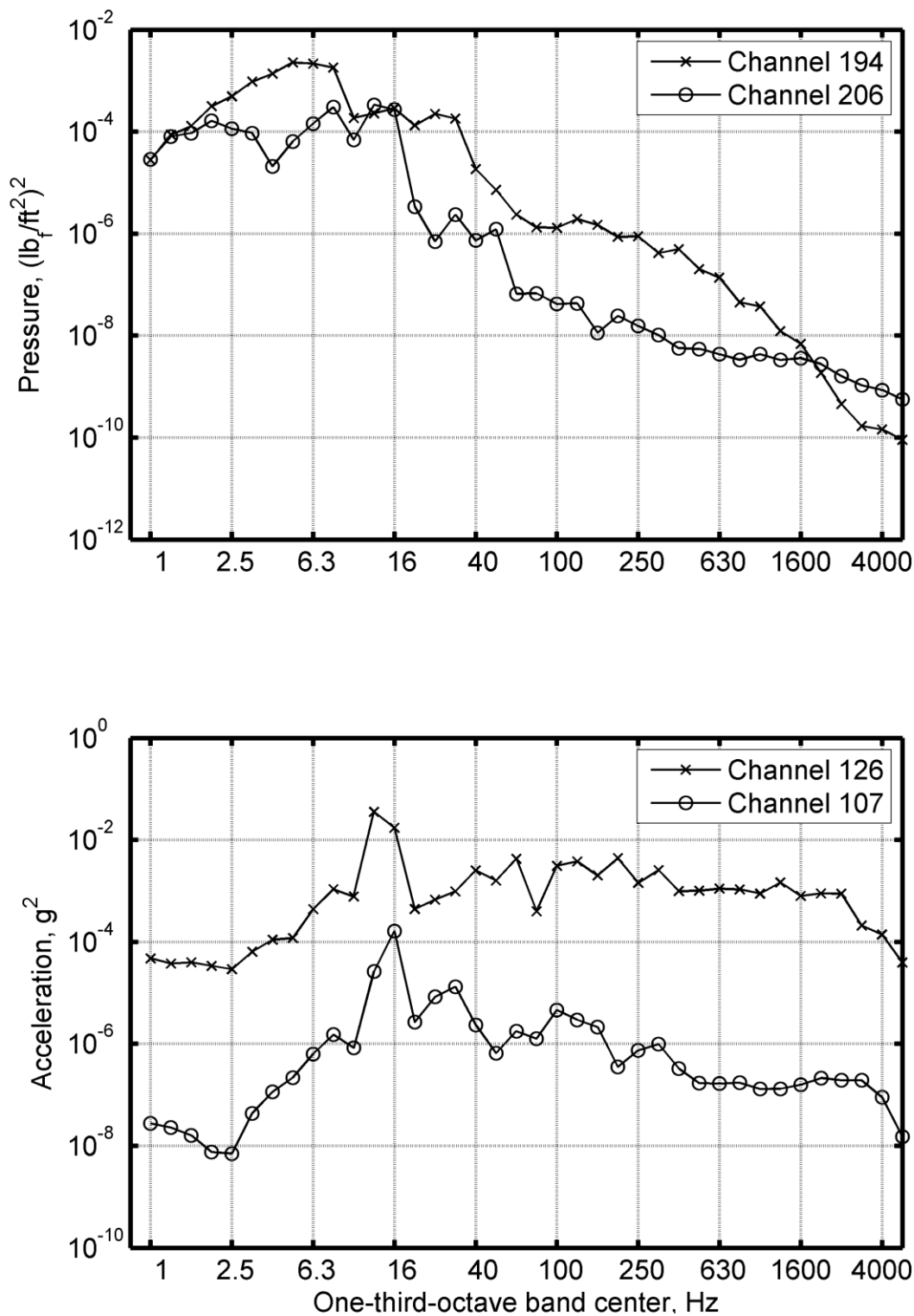


Figure 6.8: Spectra of four transducer responses for a normal amplitude sonic boom; ch. 194 is an outdoor microphone, ch. 206 is an indoor microphone, ch. 107 is a wall-mounted accelerometer, and ch. 126 is a window-mounted accelerometer.

Run 6_22_2006 9_39_45 AM_Boom6_AllChans_Ensembles_257 to 272.mat

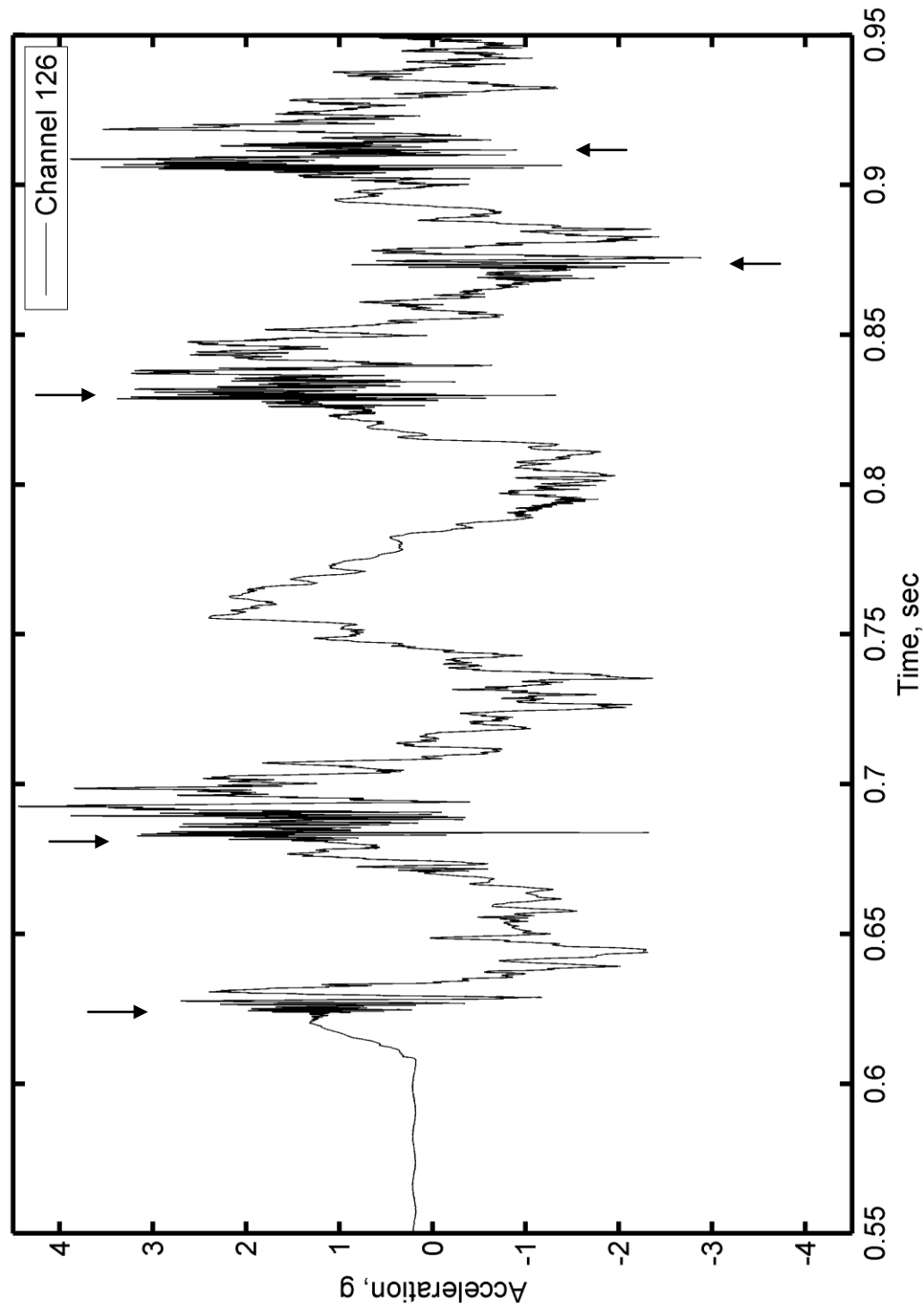


Figure 6.9: Time history of window-mounted accelerometer illustrating high frequency rattle induced vibration (marked with ↓).

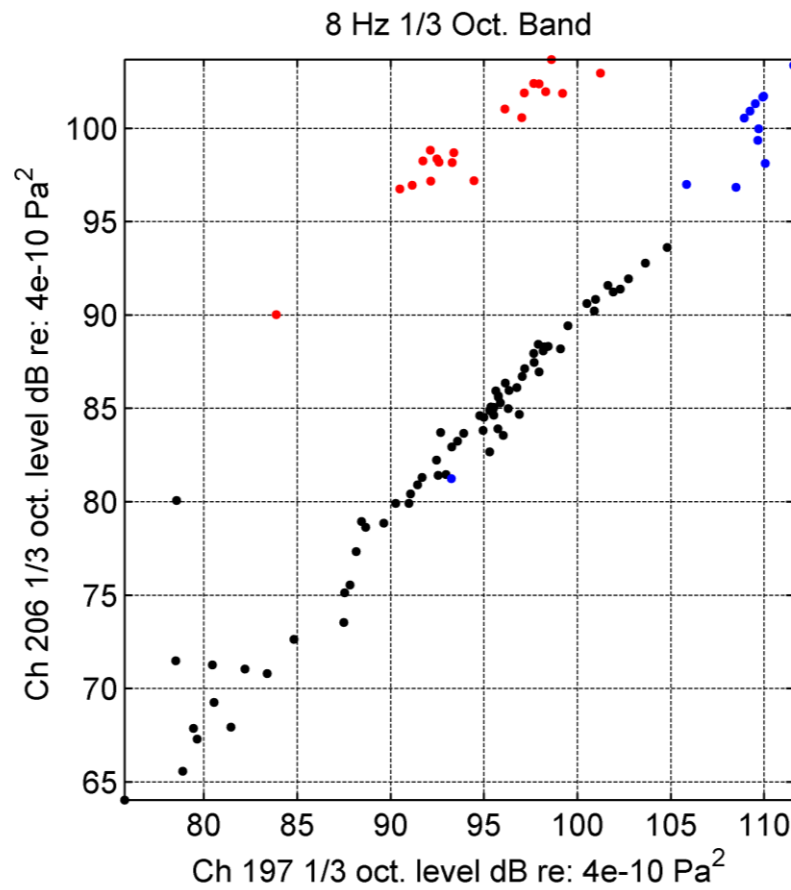


Figure 6.10: Channel 206 (an indoor microphone) response versus channel 197 (an outdoor microphone) response in the 8 Hz one-third-octave band for all 112 sonic booms; “●” low amp booms with window closed; “●” low amp booms with window open; “●” normal amp booms.

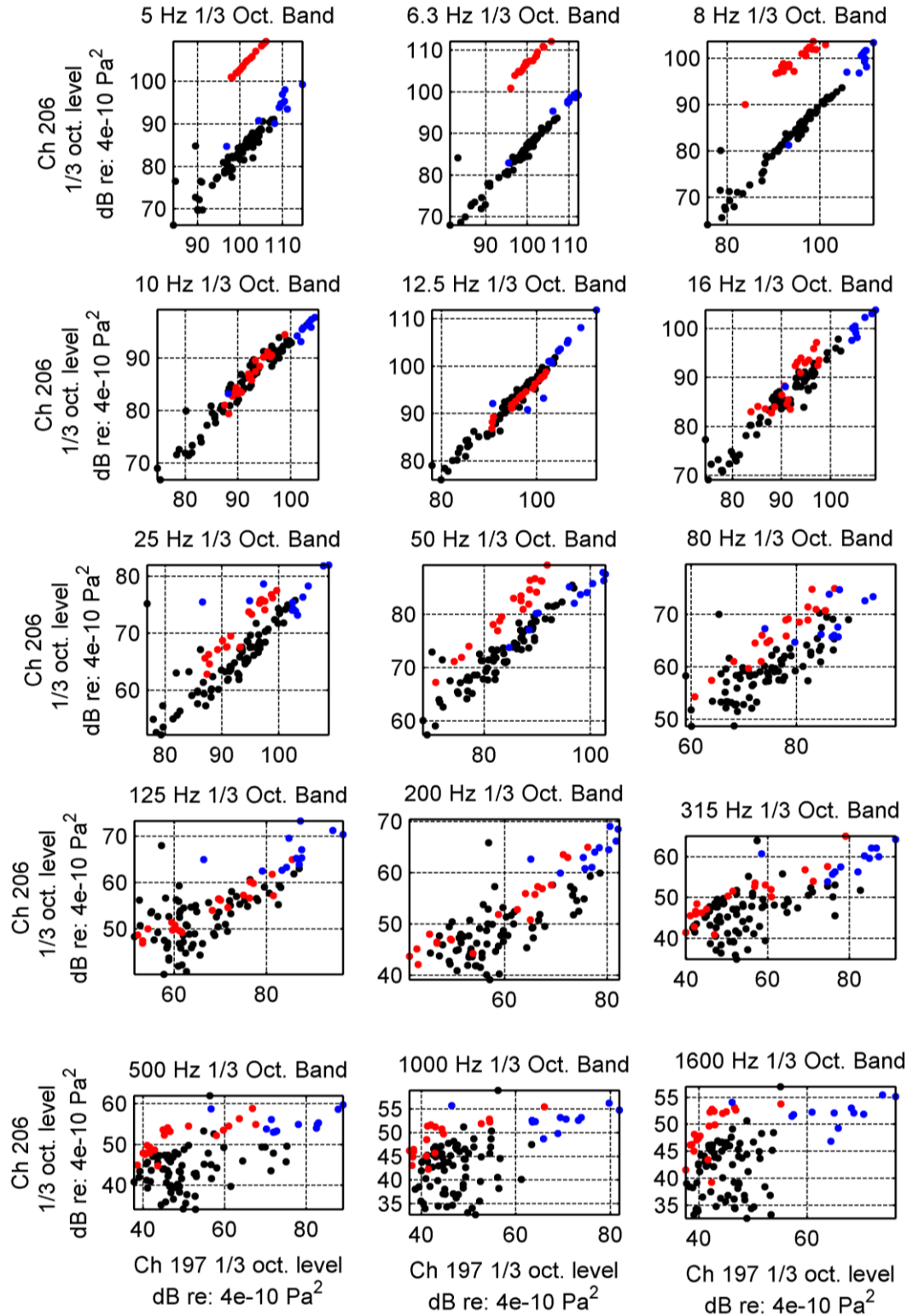


Figure 6.11: Channel 206 (an indoor microphone) versus channel 197 (an outdoor microphone) response in fifteen one-third-octave bands for all 112 sonic booms; “●” low amp booms with window closed; “●” low amp booms with window open; “●” normal amp booms.

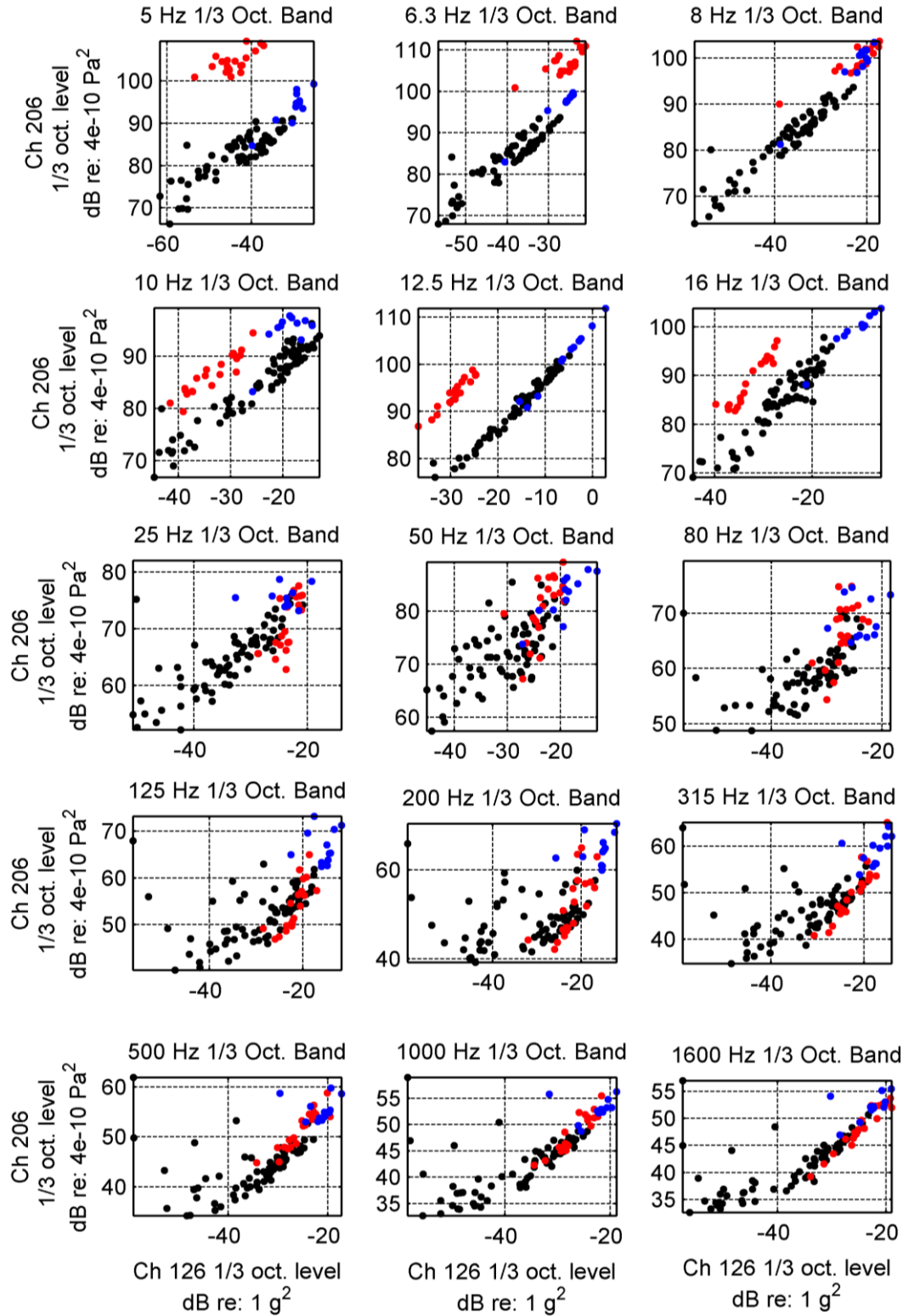
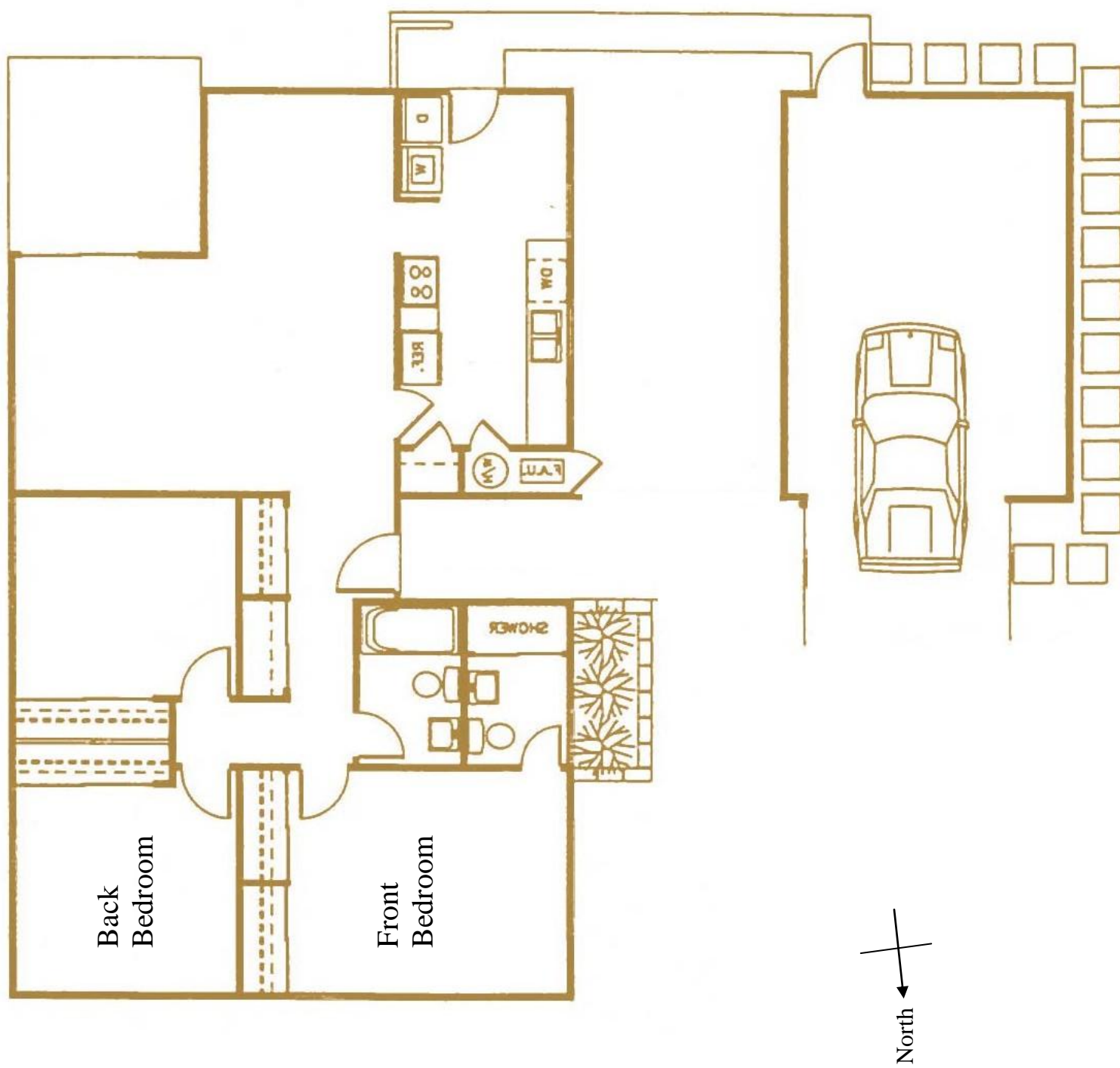


Figure 6.12: Channel 206 (an indoor microphone) versus channel 126 (a window-mounted accelerometer) response in fifteen one-third-octave bands for all 112 sonic booms; “●” low amp booms with window closed; “●” low amp booms with window open; “●” normal amp booms.

Appendix A

Drawings and photos of the two instrumented bedrooms
rooms including estimated stud locations.

(All dimensions are in inches unless otherwise noted)





Front Bedroom
West Wall



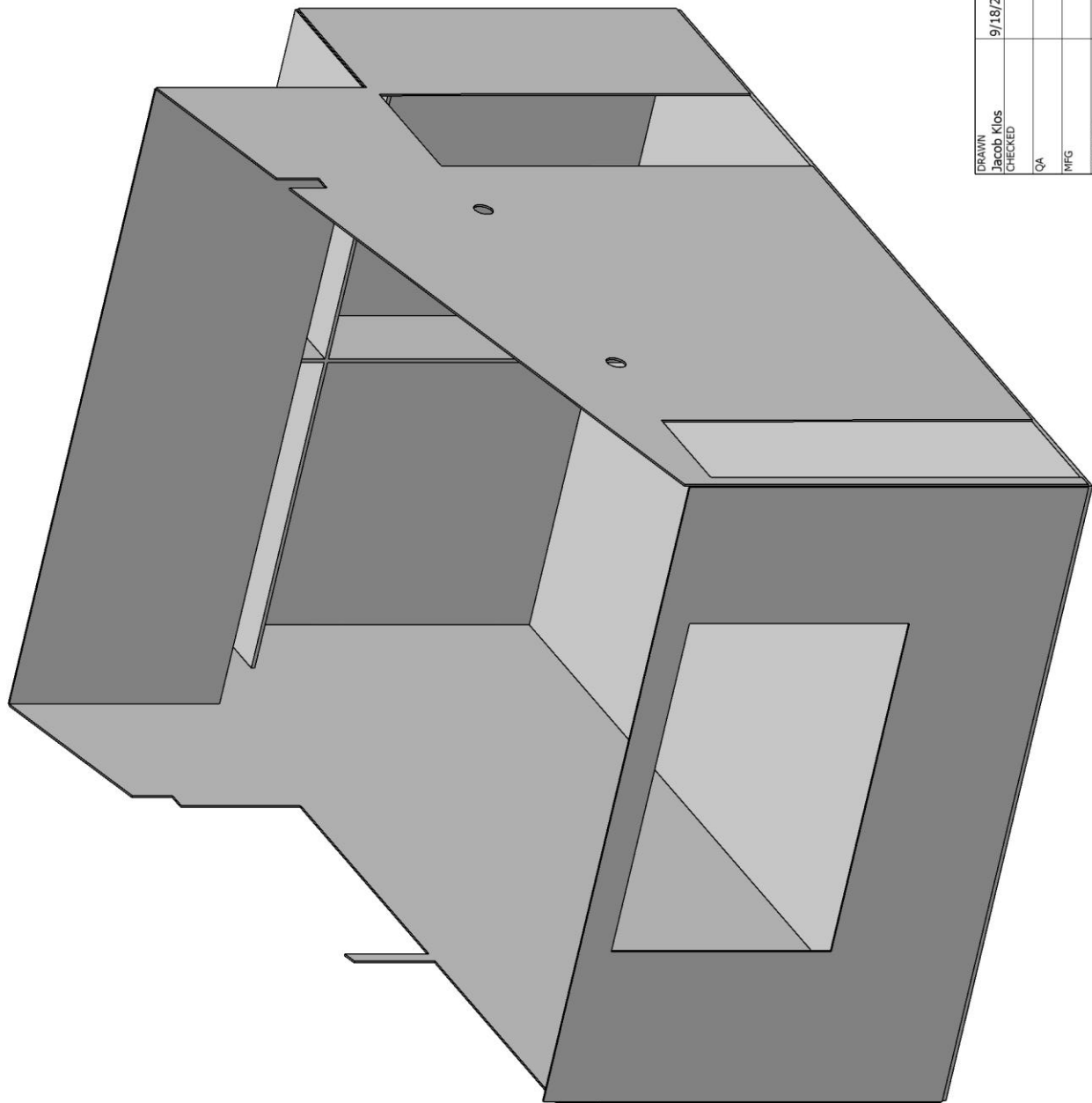
Front Bedroom
North Wall

Front Bedroom
East Wall

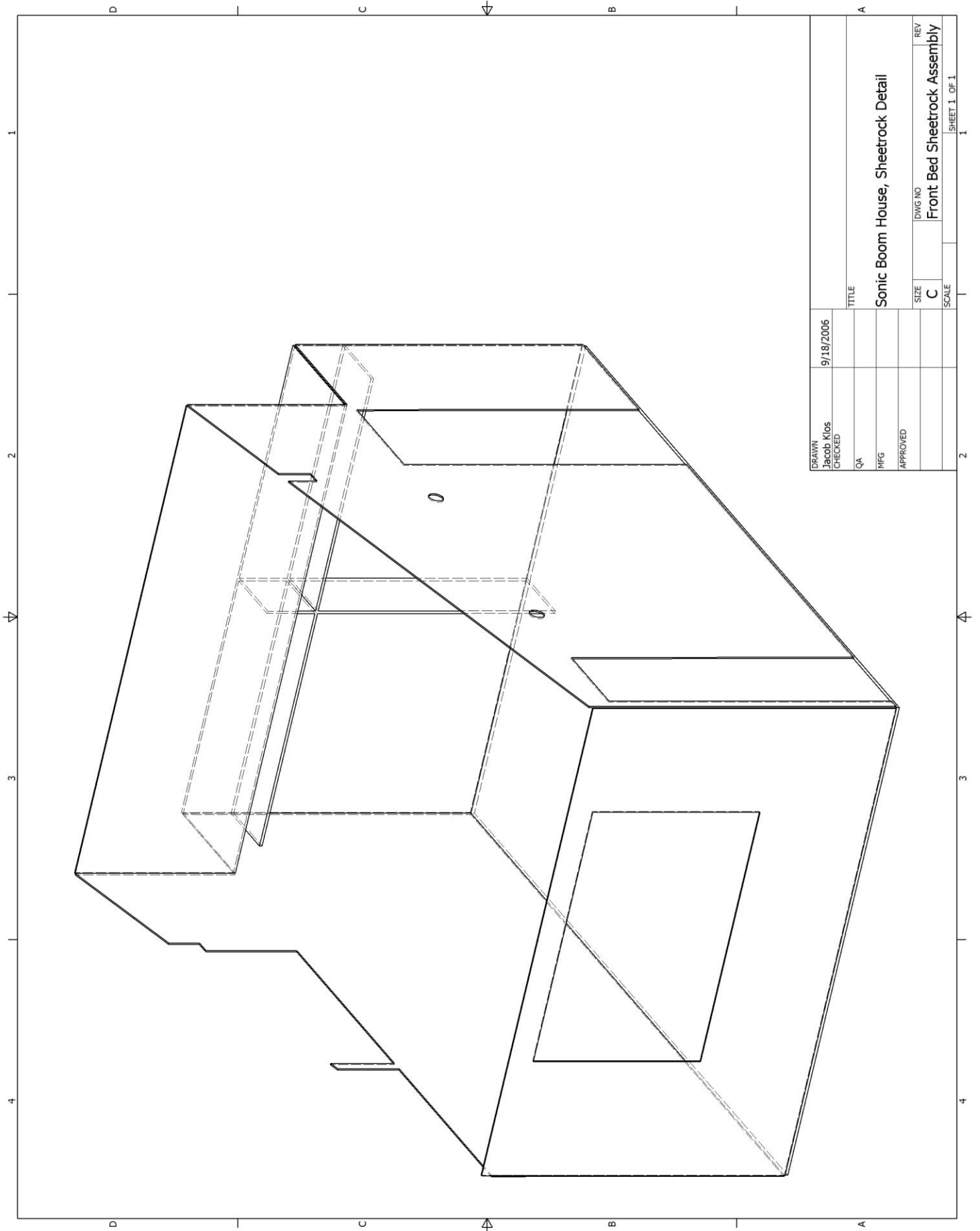




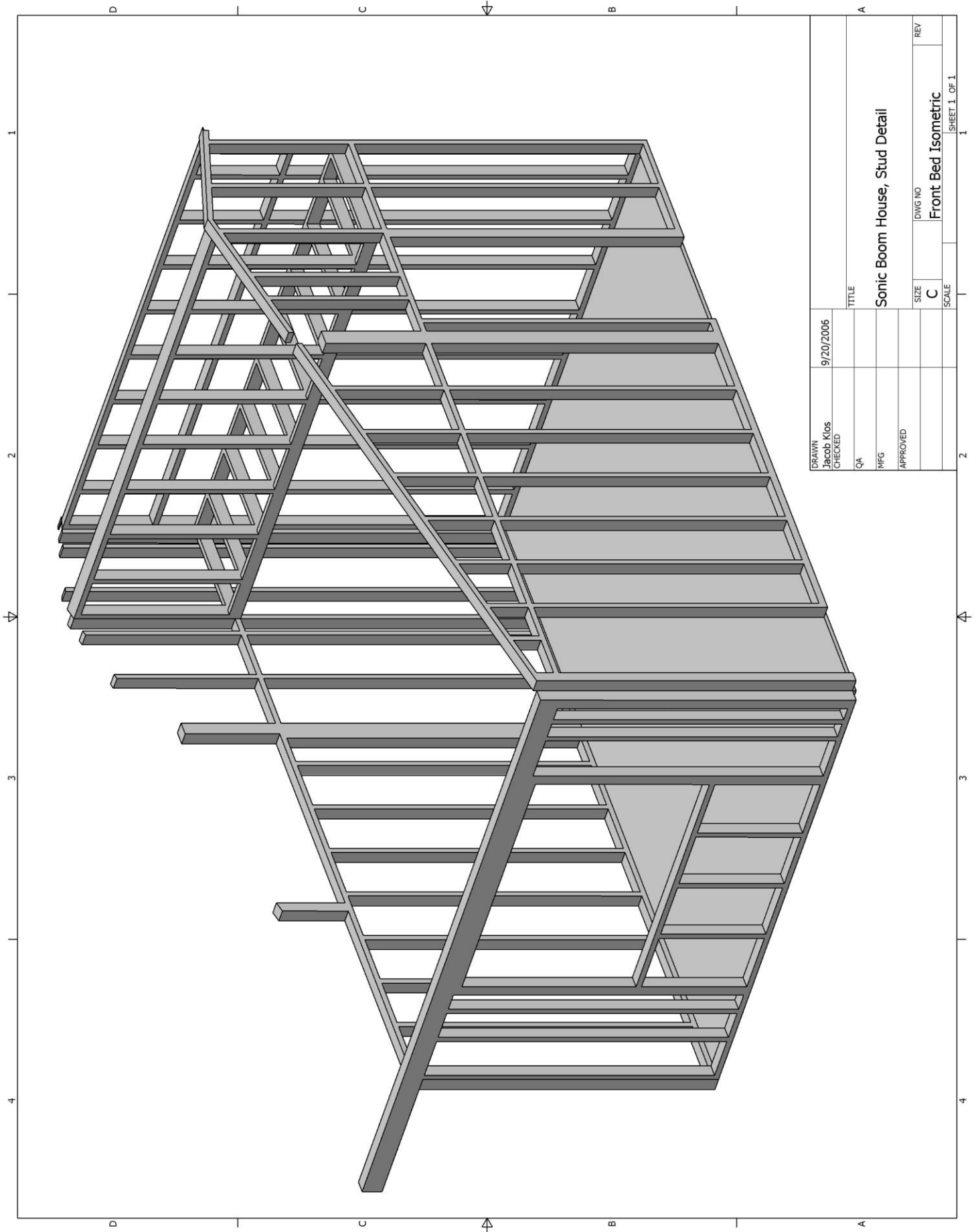
Front Bedroom
South Wall

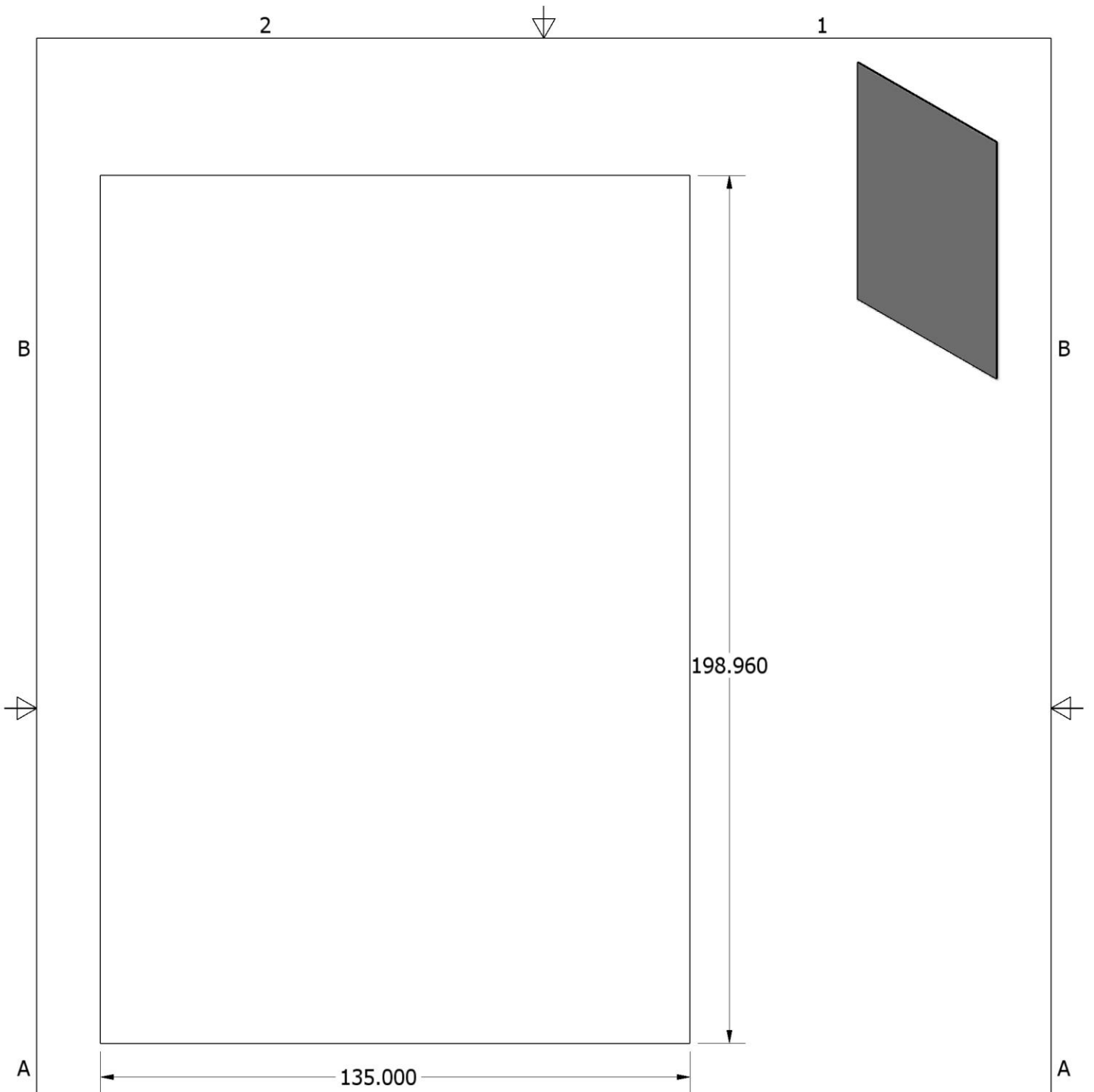


DRAWN	9/18/2006			
Jacob Klos				
CHECKED				
QA				
MFG				
APPROVED				
TITLE		Sonic Boom House, Sheetrock Detail		
SIZE	DWG NO	REV		
C			Front Bed Sheetrock Assembly	
SCALE				
2	1	SHEET 1 OF 1		

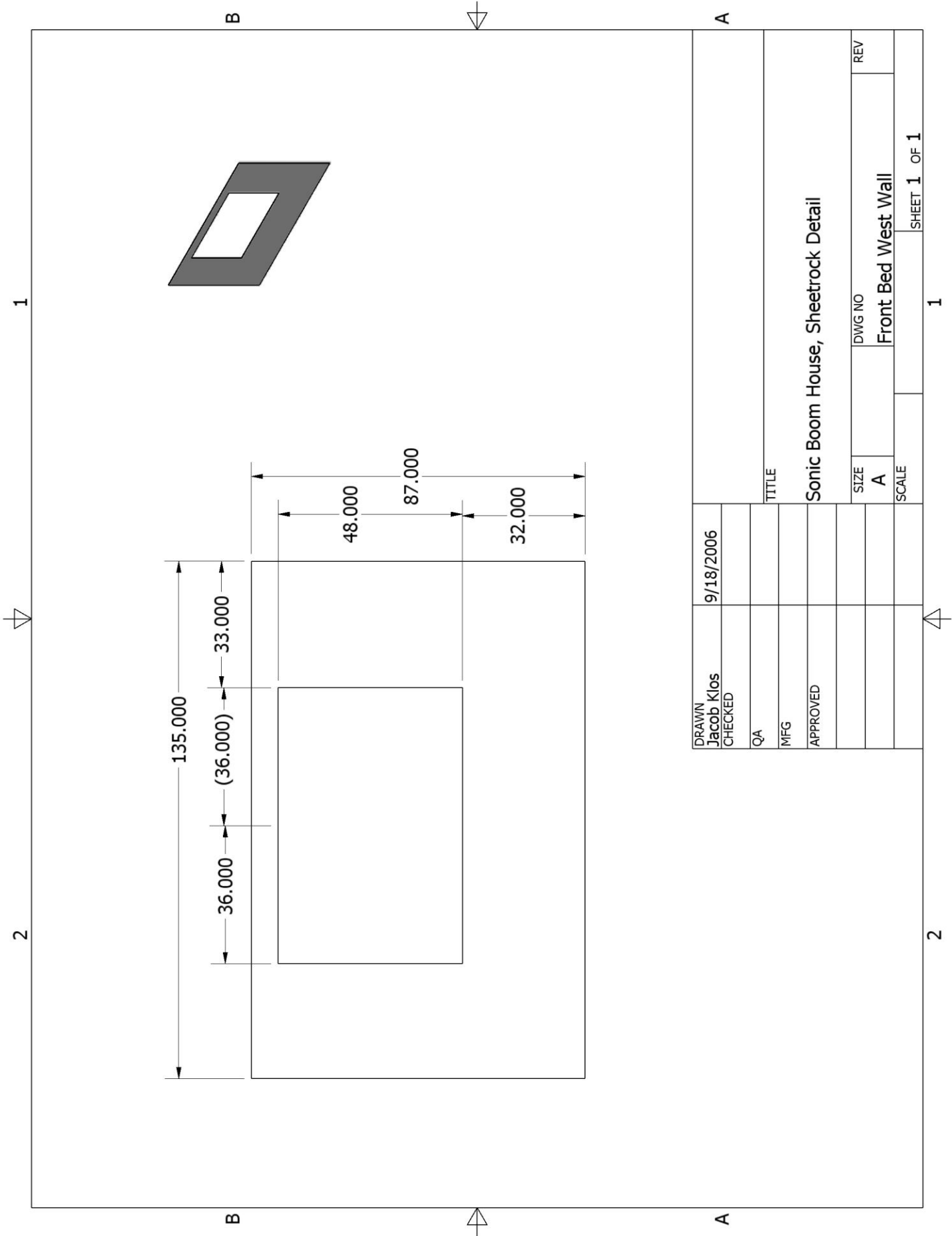


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MFG		Sonic Boom House, Sheetrock Detail			
APPROVED					
		SIZE C	DWG NO	REV	
		SCALE	Front Bed Sheetrock Assembly		
2		SHEET 1 OF 1			1

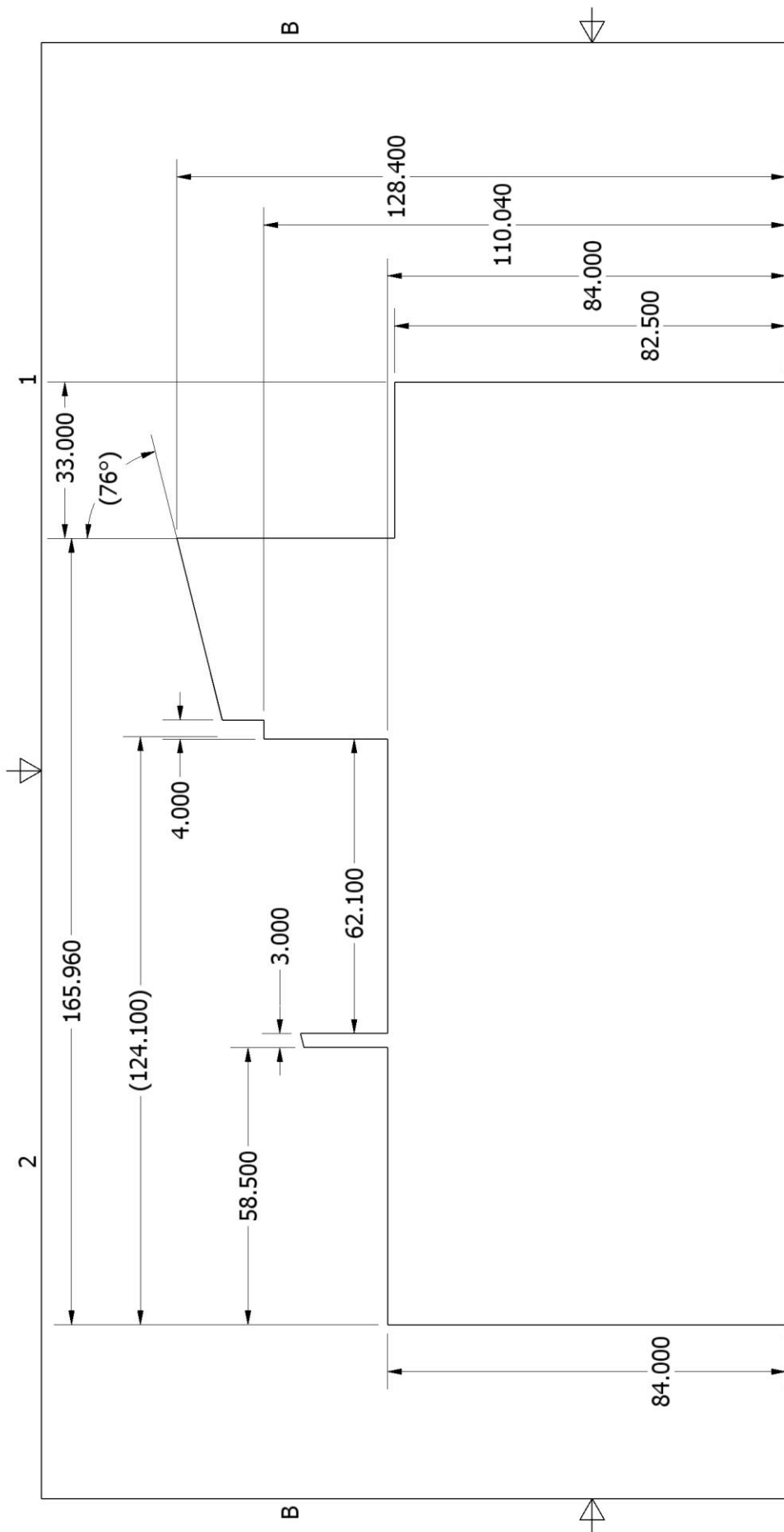





DRAWN	Jacob Klos	9/18/2006			
CHECKED					
QA			TITLE		
MFG					
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			SCALE	SHEET 1 OF 1	

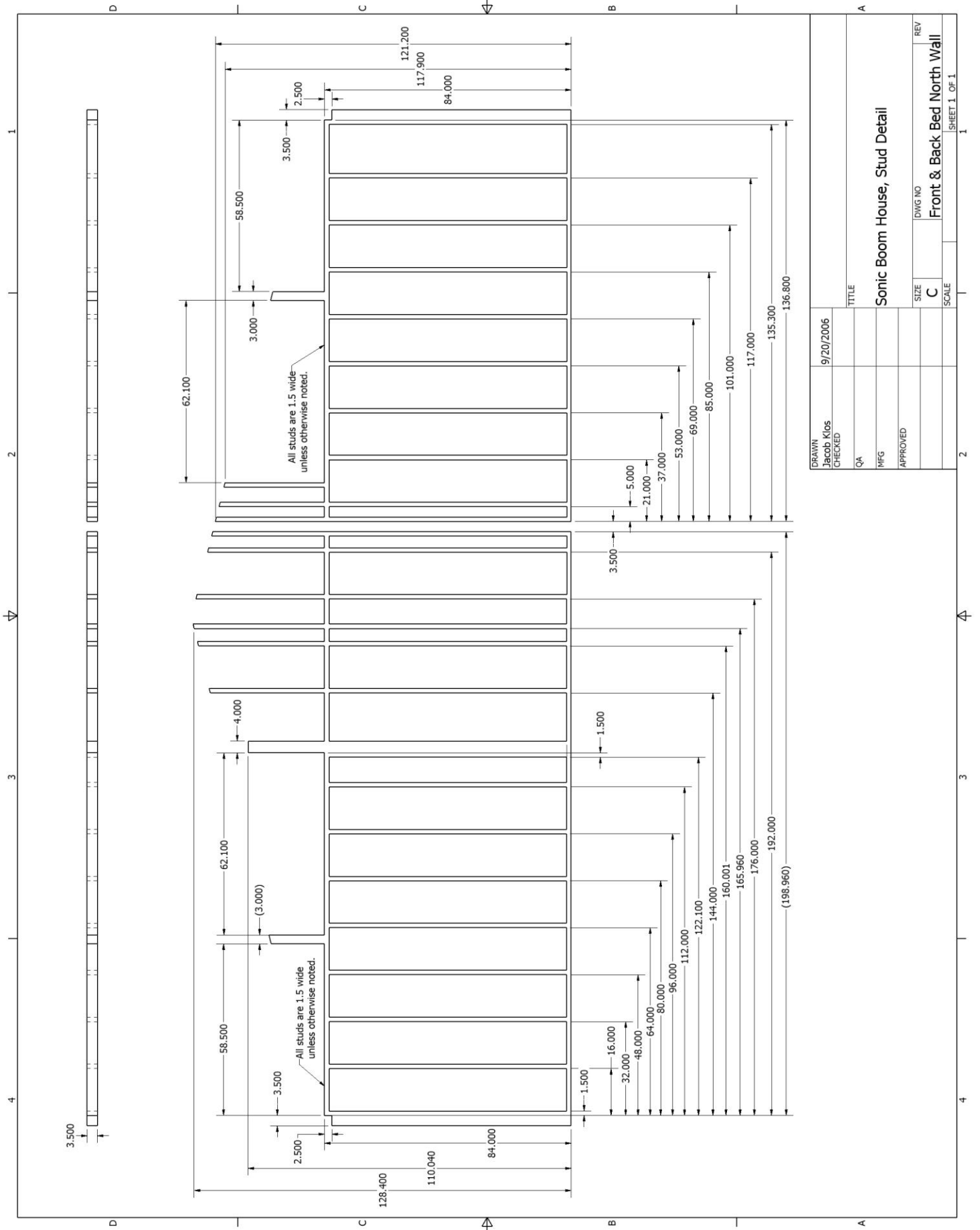


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Jacob Klos			
CHECKED		TITLE	
QA			
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APPROVED			
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		A	
		SCALE	REV
		SHEET 1 OF 1	

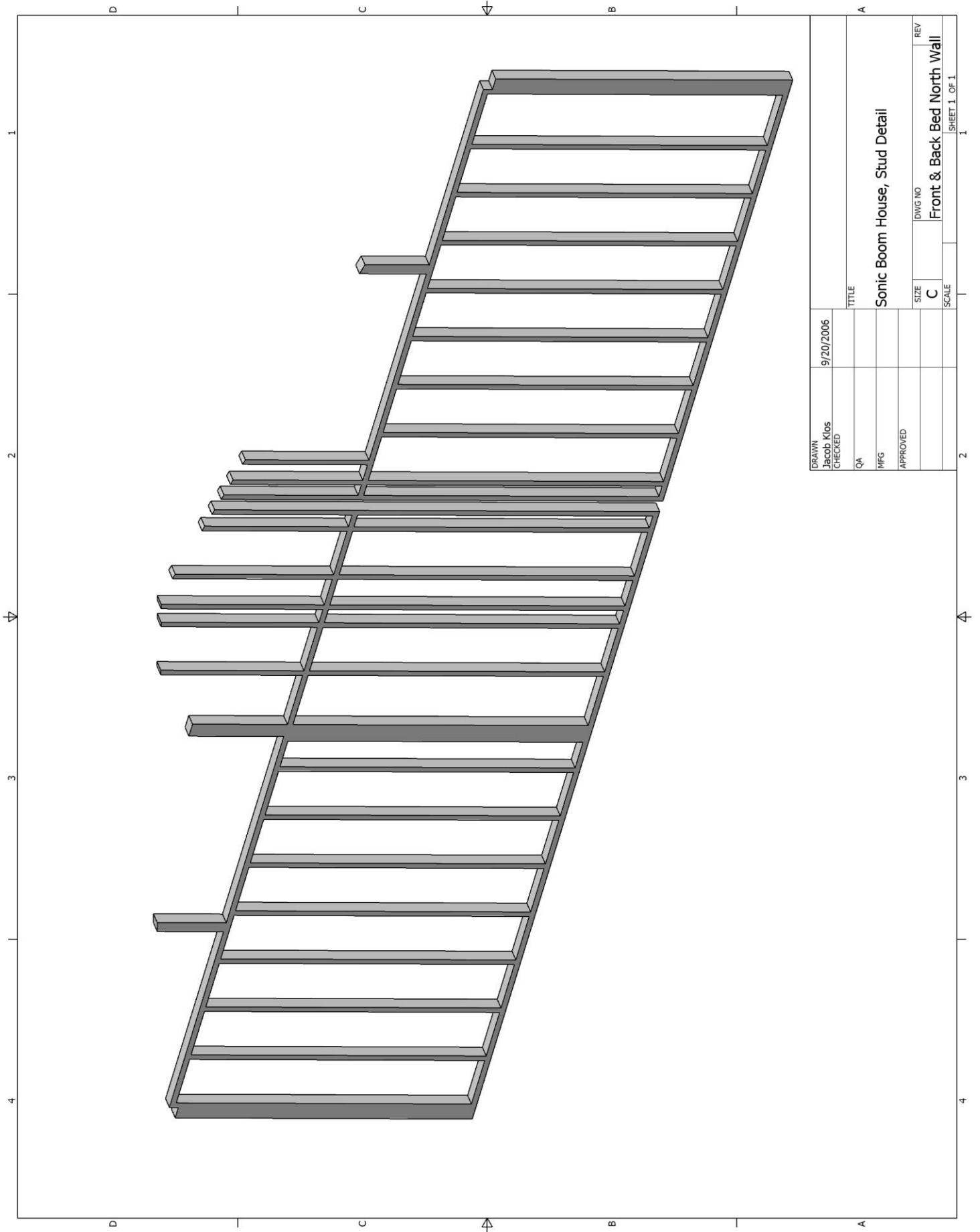




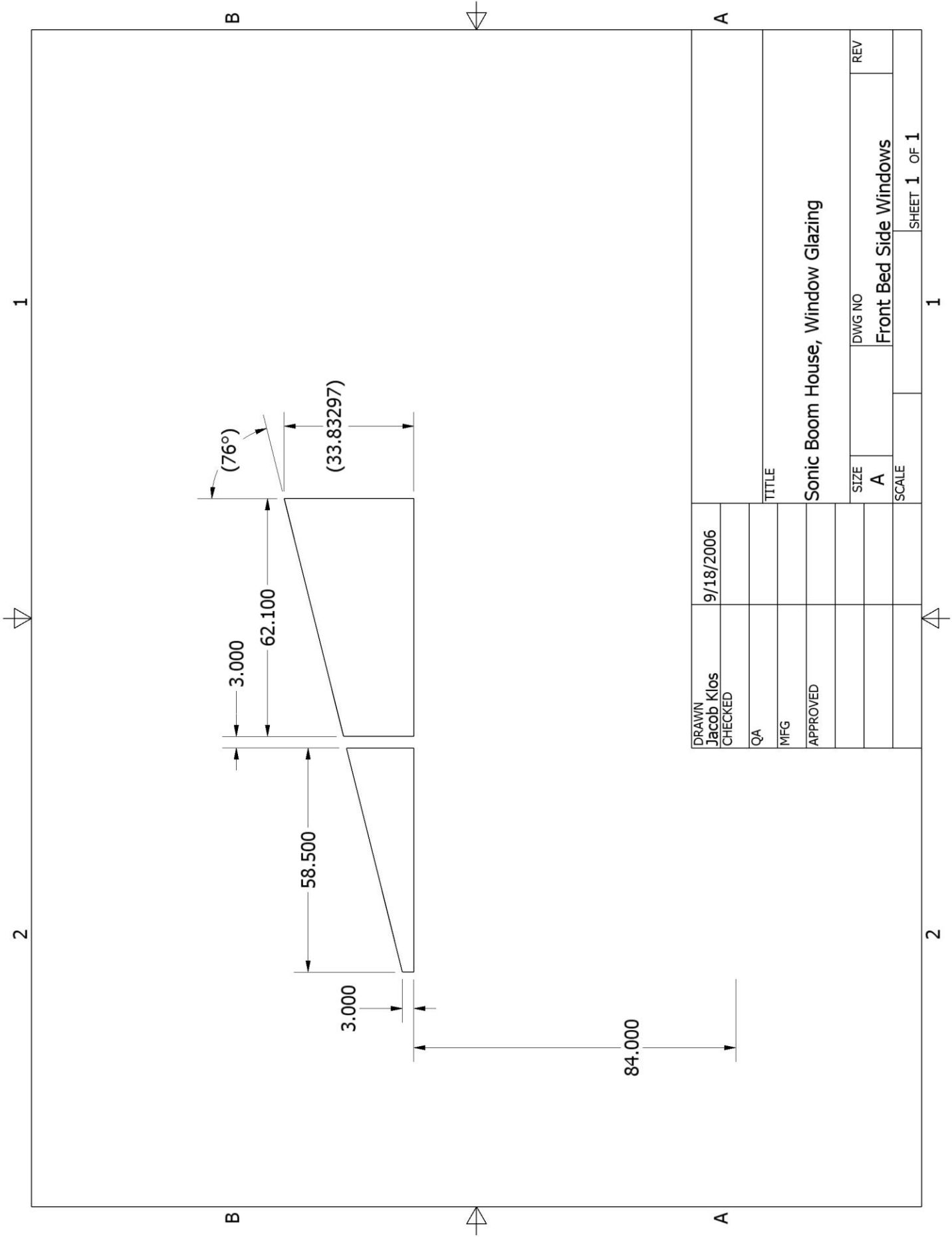
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Jacob Klos			
CHECKED			
QA			
MFG			
APPROVED			
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SIZE		DWG NO	REV
A			
SCALE		Front Bed North Wall	
		SHEET 1 OF 1	

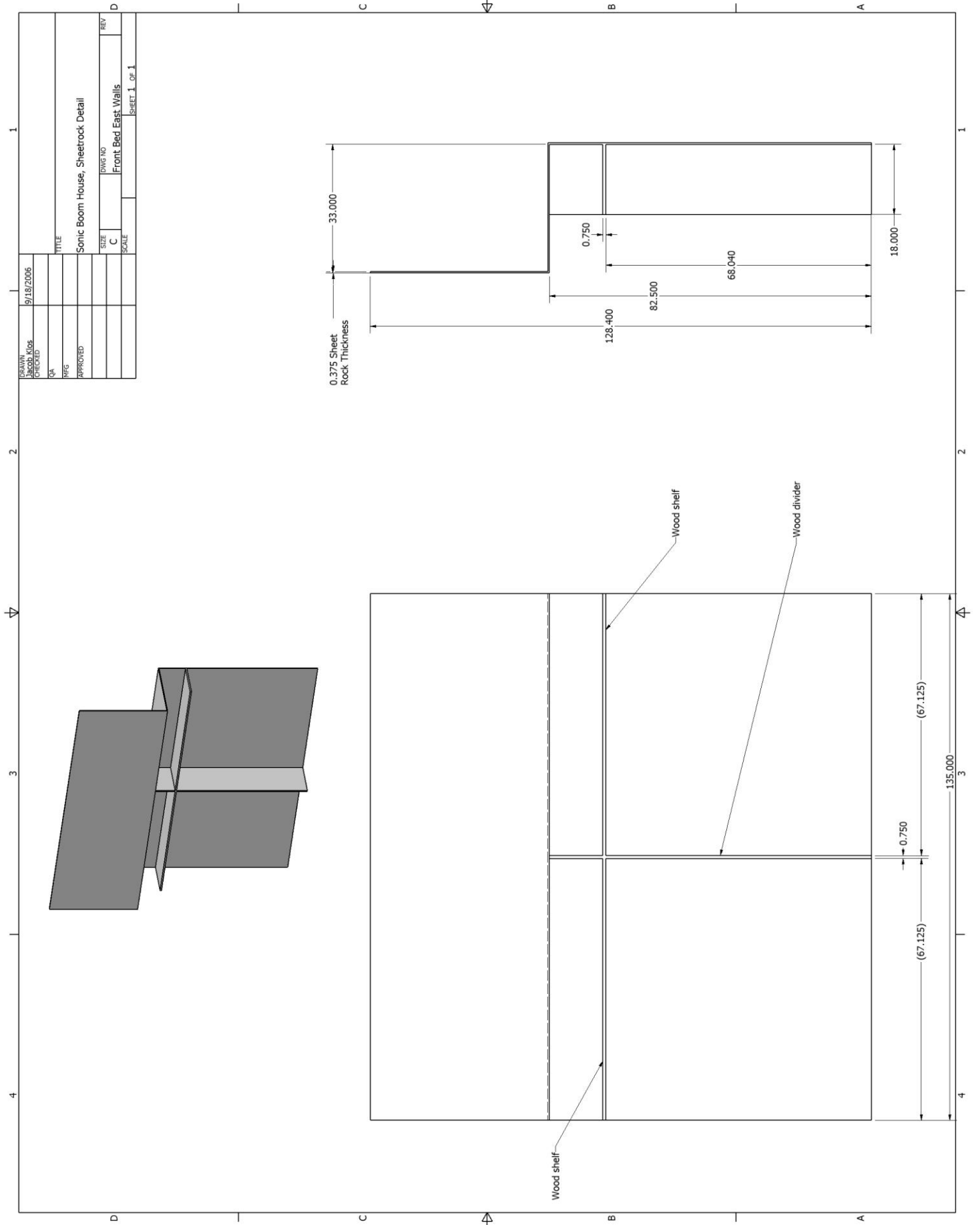


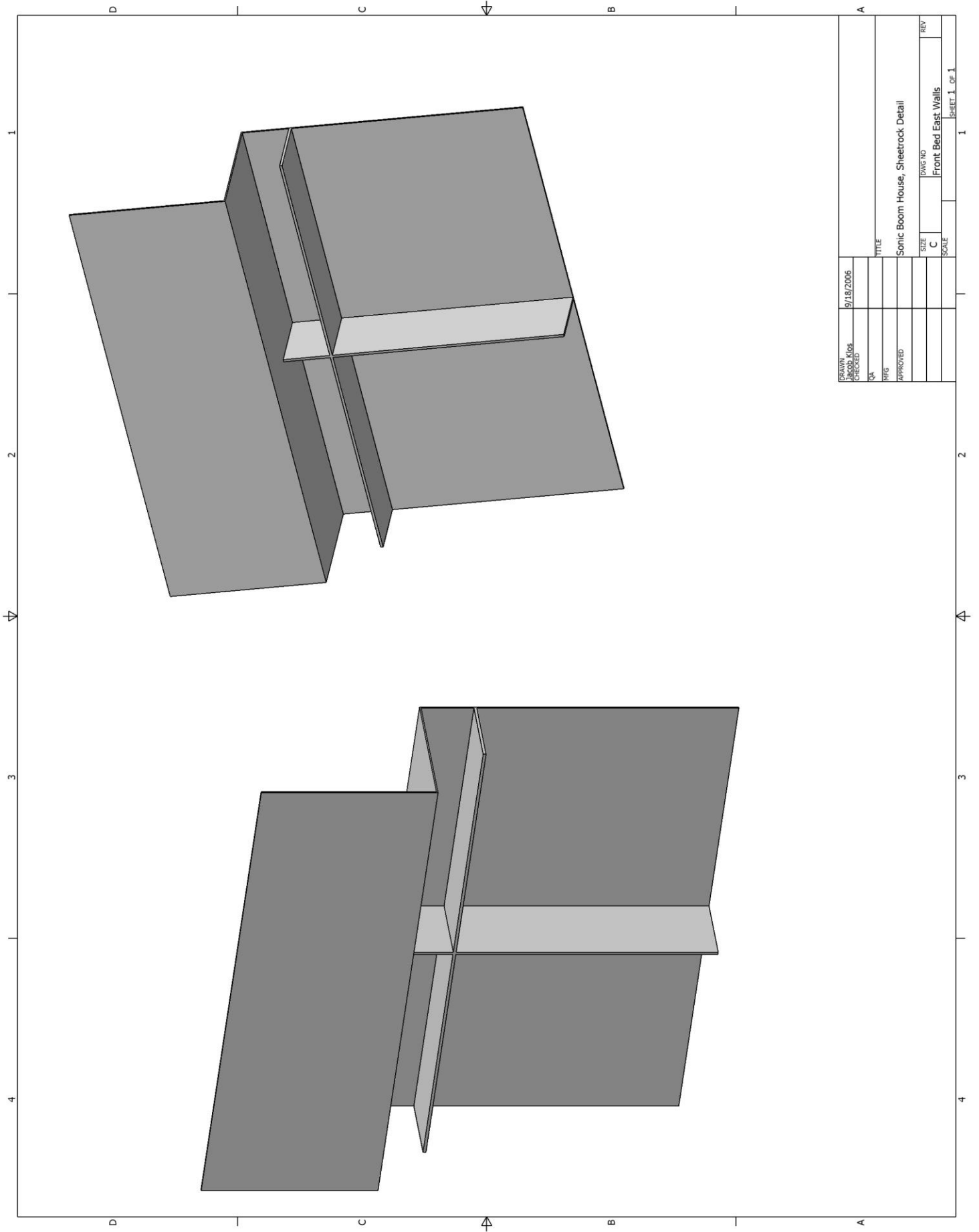
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	MFG		DWG NO	
	APPROVED		REV	
SIZE		C	Front & Back Bed North Wall	
SCALE			SHEET 1 OF 1	



DRAWN Jacob Klos CHECKED	9/20/2006					2
QA		TITLE				
MFG		Sonic Boom House, Stud Detail				
APPROVED		SIZE C	DWG NO	REV	Front & Back Bed North Wall	
		SCALE				
		SHEET 1 OF 1				1





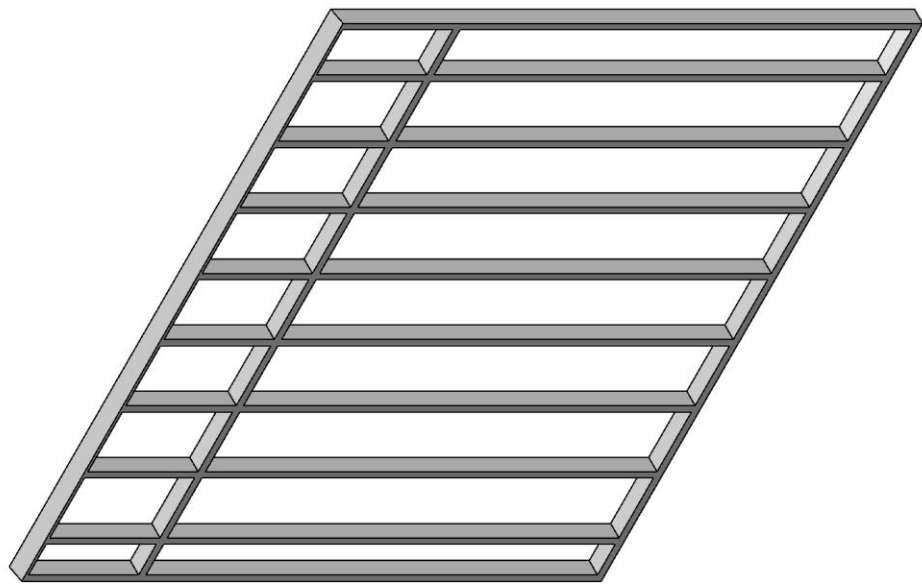


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CHECKED			
QA			
DATE			
APPROVED		TITLE	
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		REV	
		SCALE	
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		SHEET 1 OF 1	

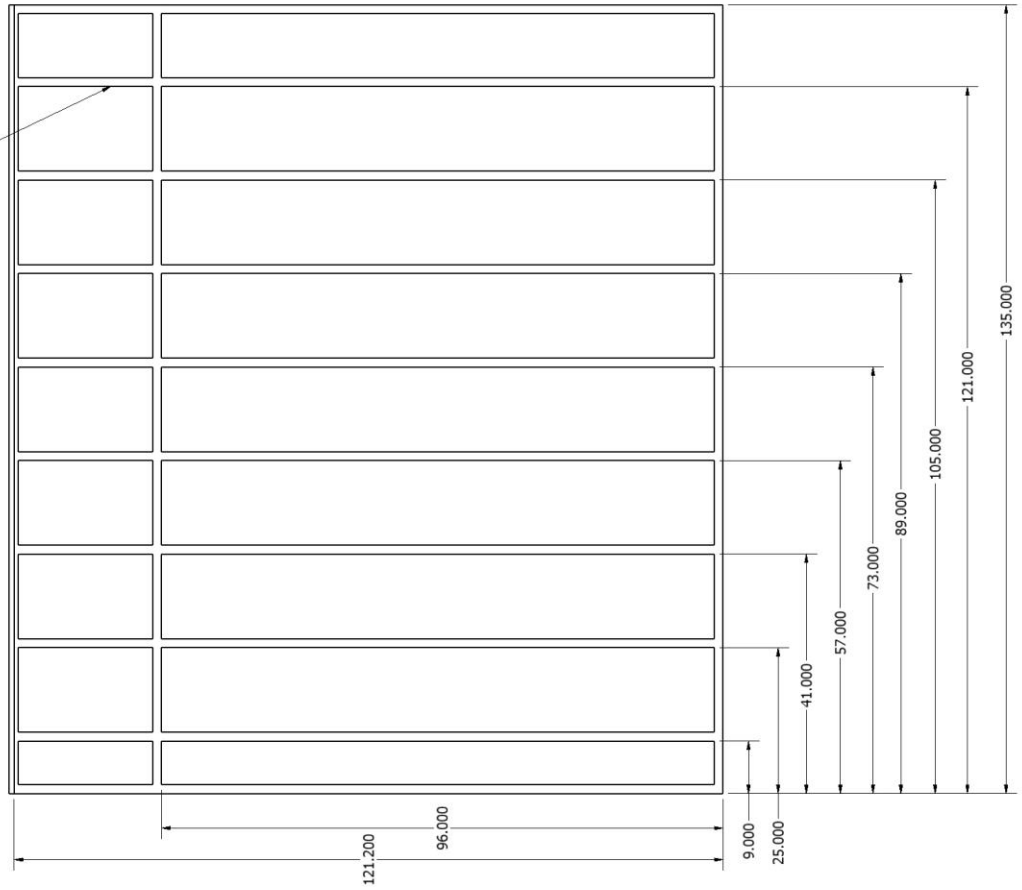
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QA		Sonic Boom House, Stud Detail		DWG NO
MFG		SIZE	C	REV
APPROVED		SCALE		SHEET 1 OF 1

Back Bed West Wall (Common With Front Bed East Wall)

Note:
This wall is the common wall
between the front and back
bedrooms. The closet detail
has been left off for simplicity.



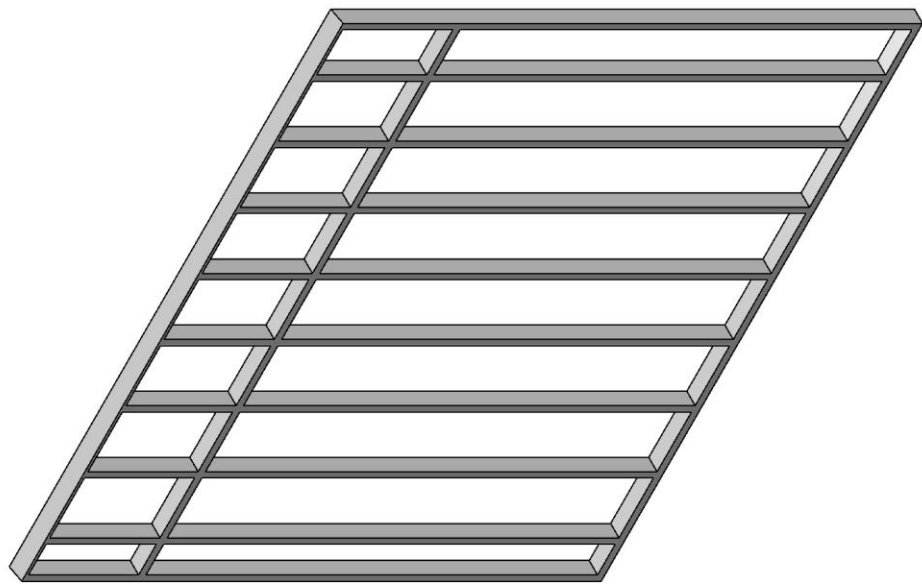
All studs are 1.5 wide
unless otherwise noted.



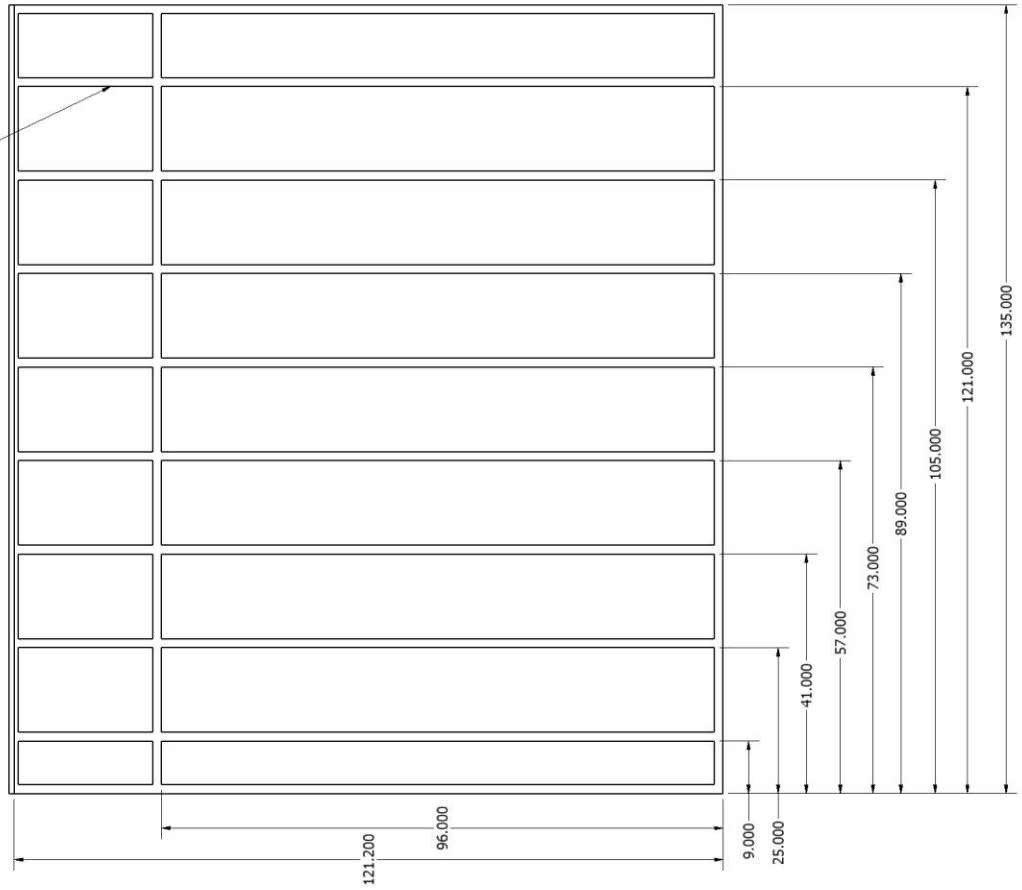
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MFG		SIZE	C	REV
APPROVED		SCALE		SHEET 1 OF 1

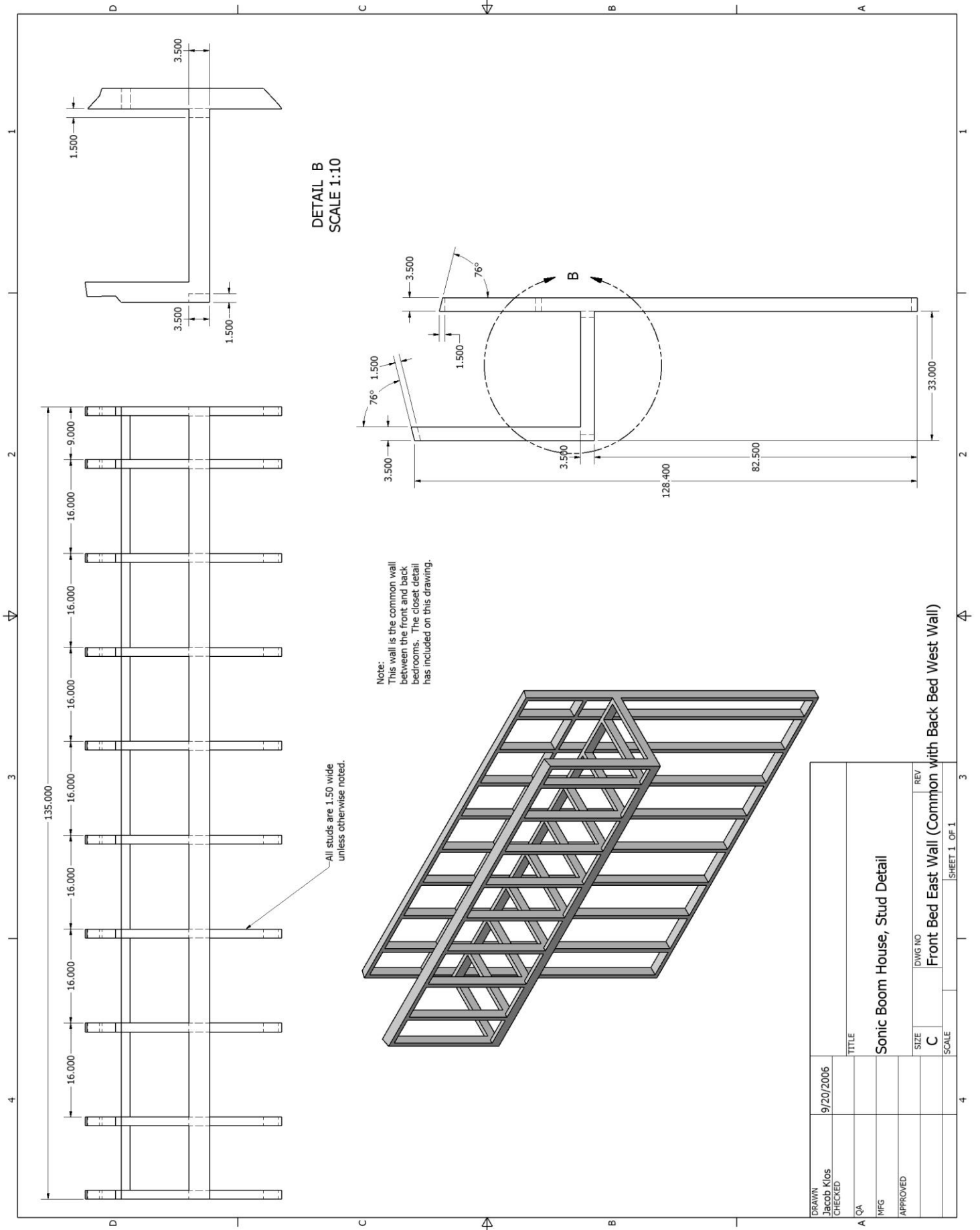
Back Bed West Wall (Common With Front Bed East Wall)

Note:
This wall is the common wall
between the front and back
bedrooms. The closet detail
has been left off for simplicity.



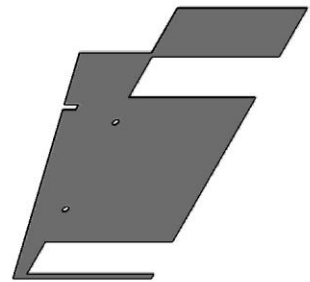
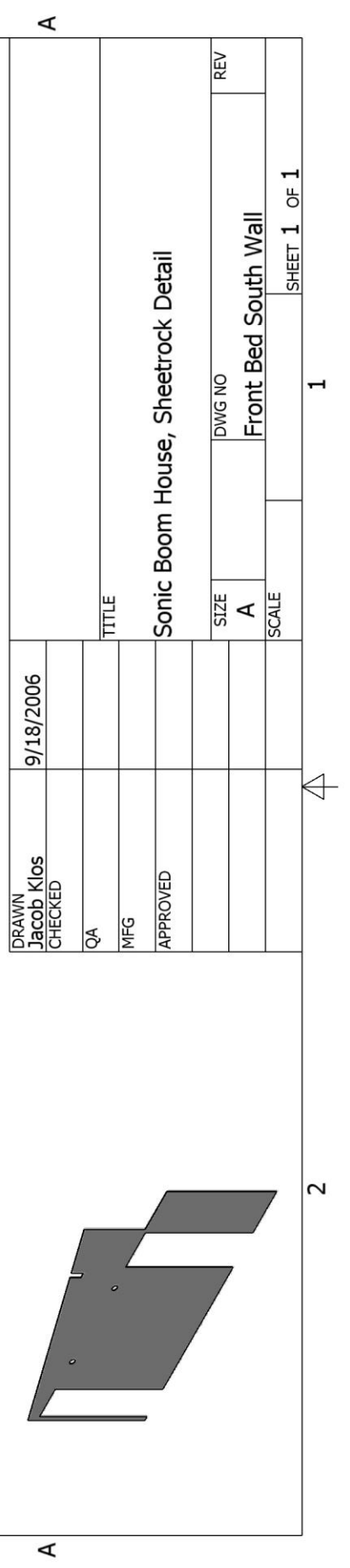
All studs are 1.5 wide
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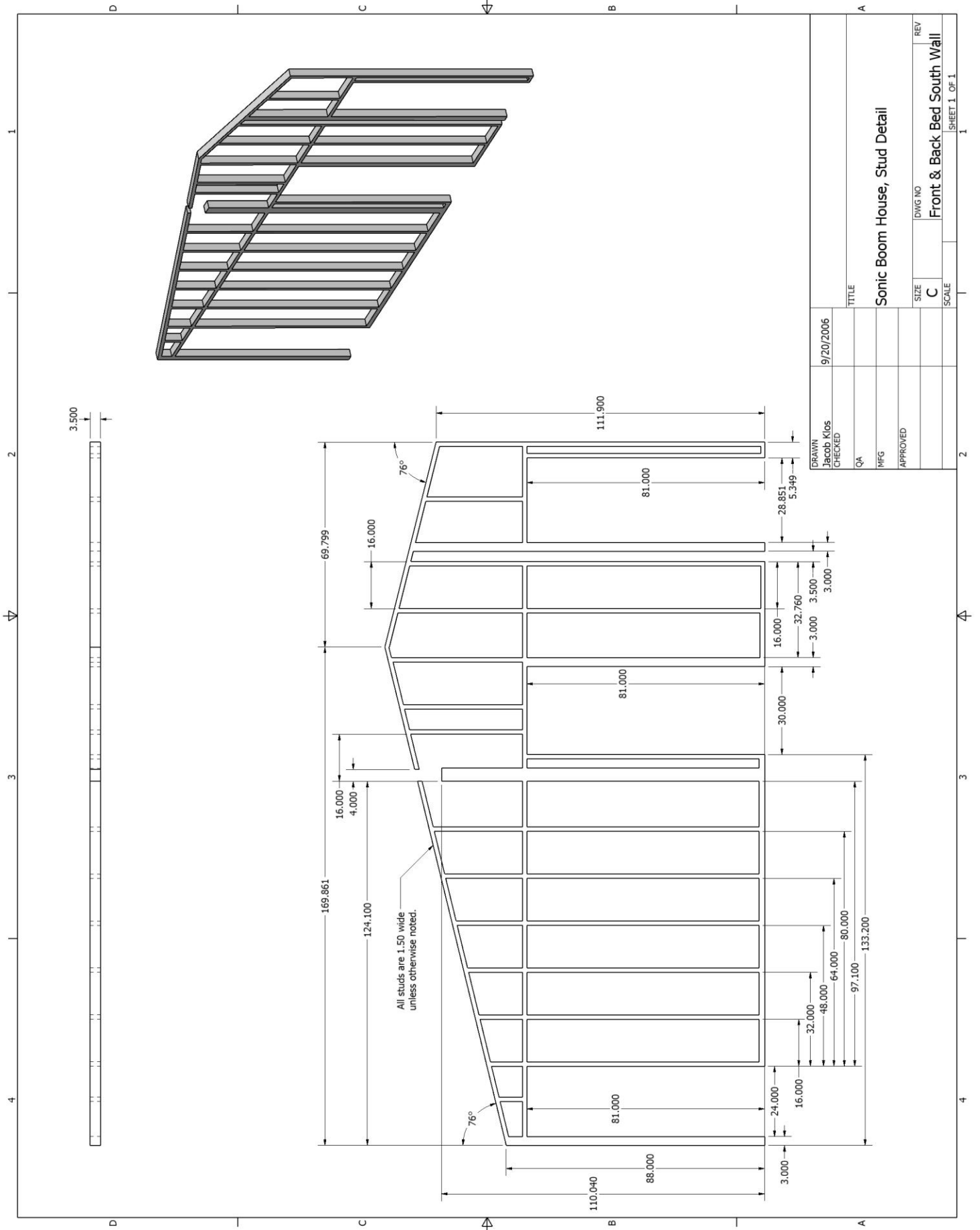




DRAWN	9/20/2006	TITLE	Front Bed East Wall (Common with Back Bed West Wall)
CHECKED		SIZE	C
QA		DWG NO	
MFG		REV	
APPROVED		SCALE	1 OF 1

Sonic Boom House, Stud Detail







Back Bedroom
East Wall

Back Bedroom
South Wall

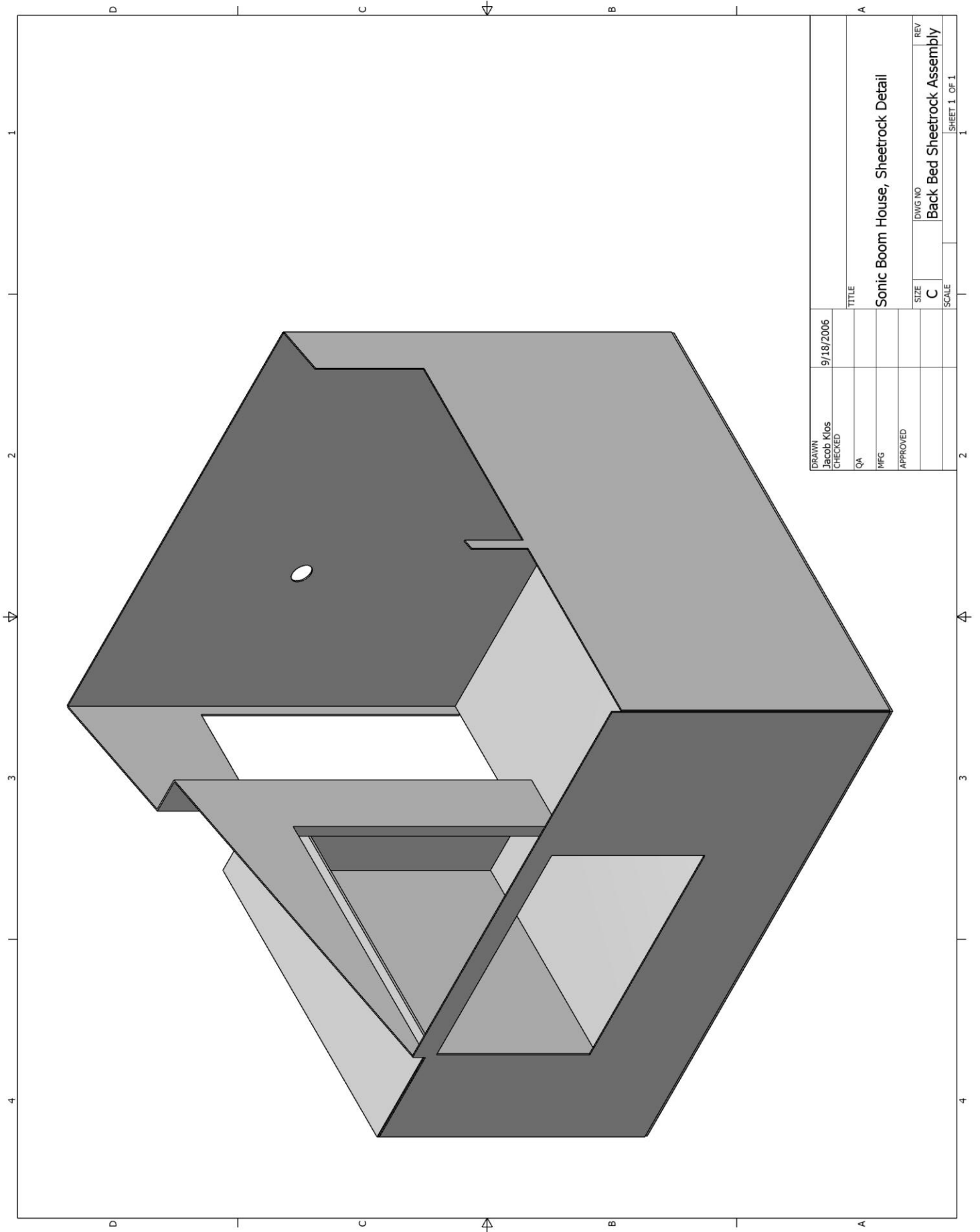


Back Bedroom
West Wall

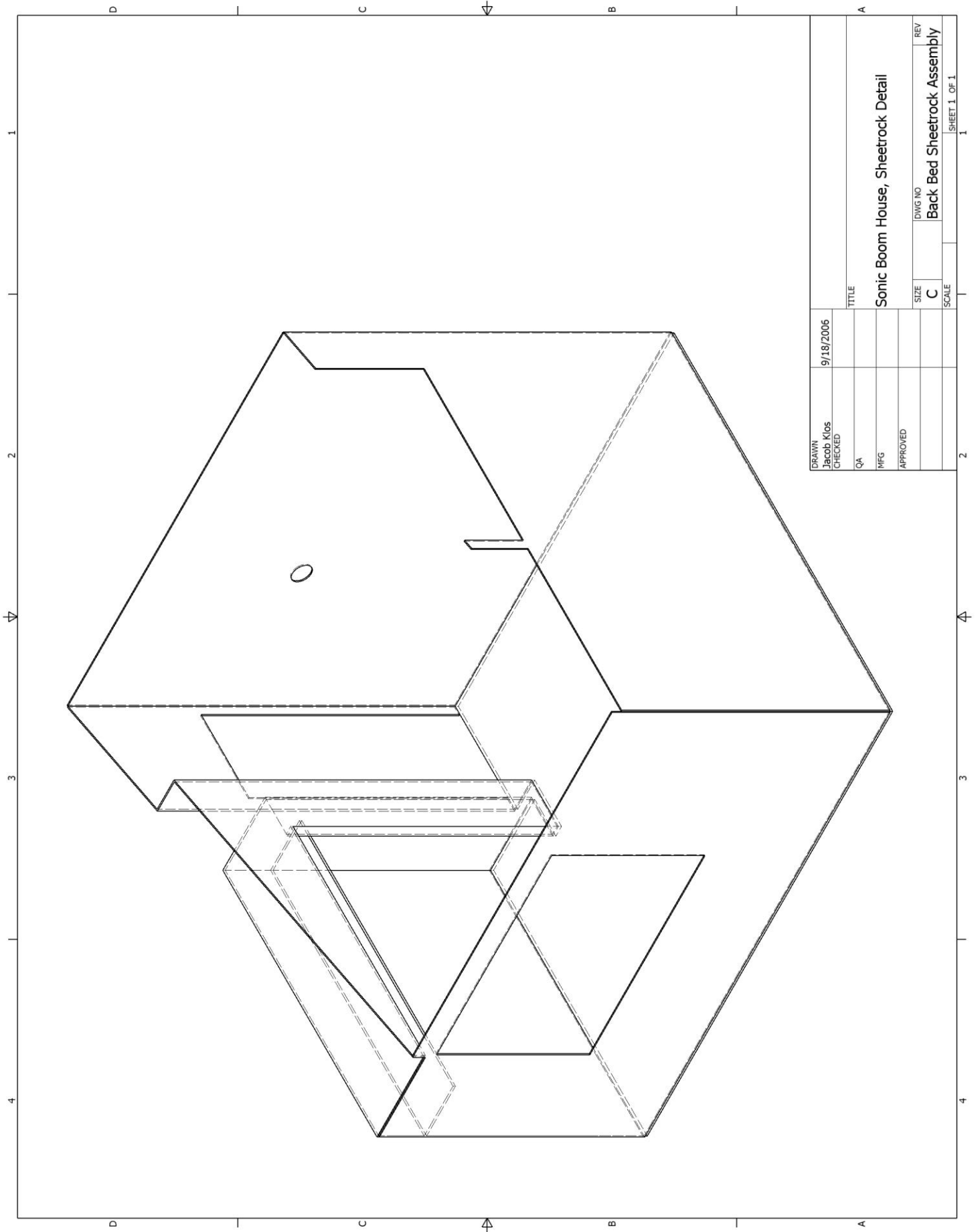


Back Bedroom
North Wall

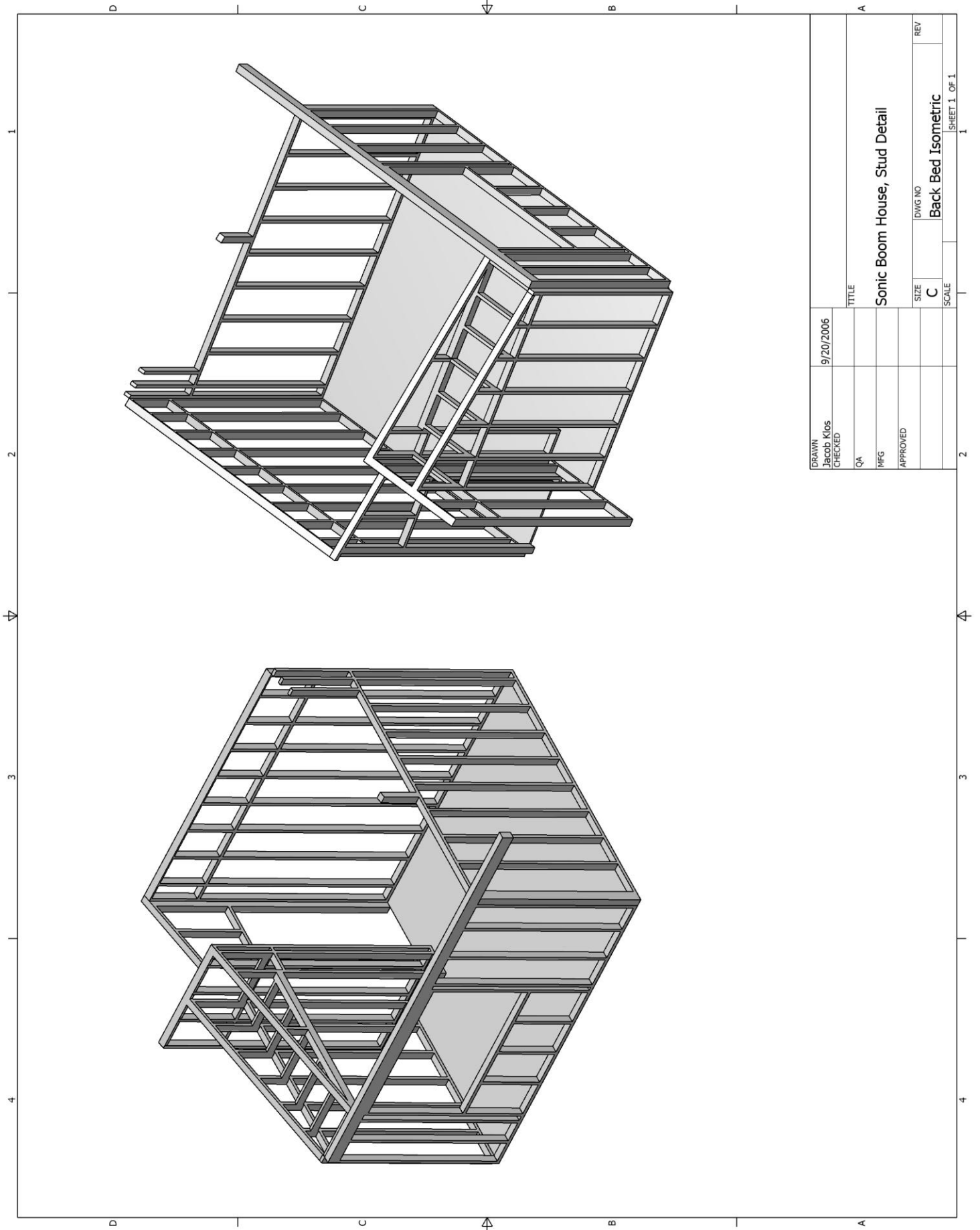




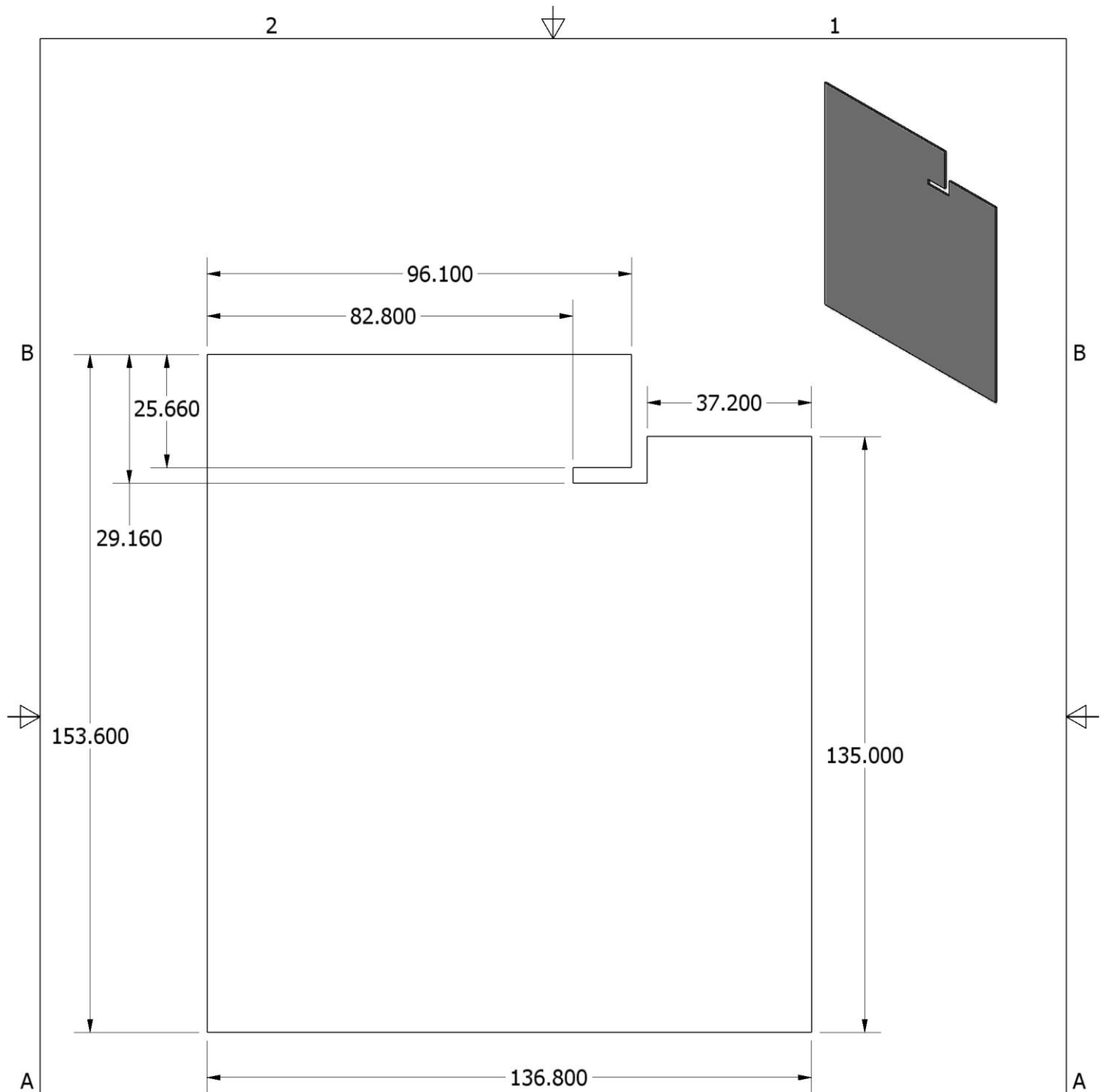
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QA			
MFG			
APPROVED			
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		C	
		DWG NO	
		Back Bed Sheetrock Assembly	
		SCALE	
		SHEET 1 OF 1	
		1	2



DRAWN Jacob Klos	9/18/2006	TITLE	
CHECKED		Sonic Boom House, Sheetrock Detail	
QA		SIZE	REV
MFG		C	
APPROVED		DWG NO	Back Bed Sheetrock Assembly
		SCALE	SHEET 1 OF 1



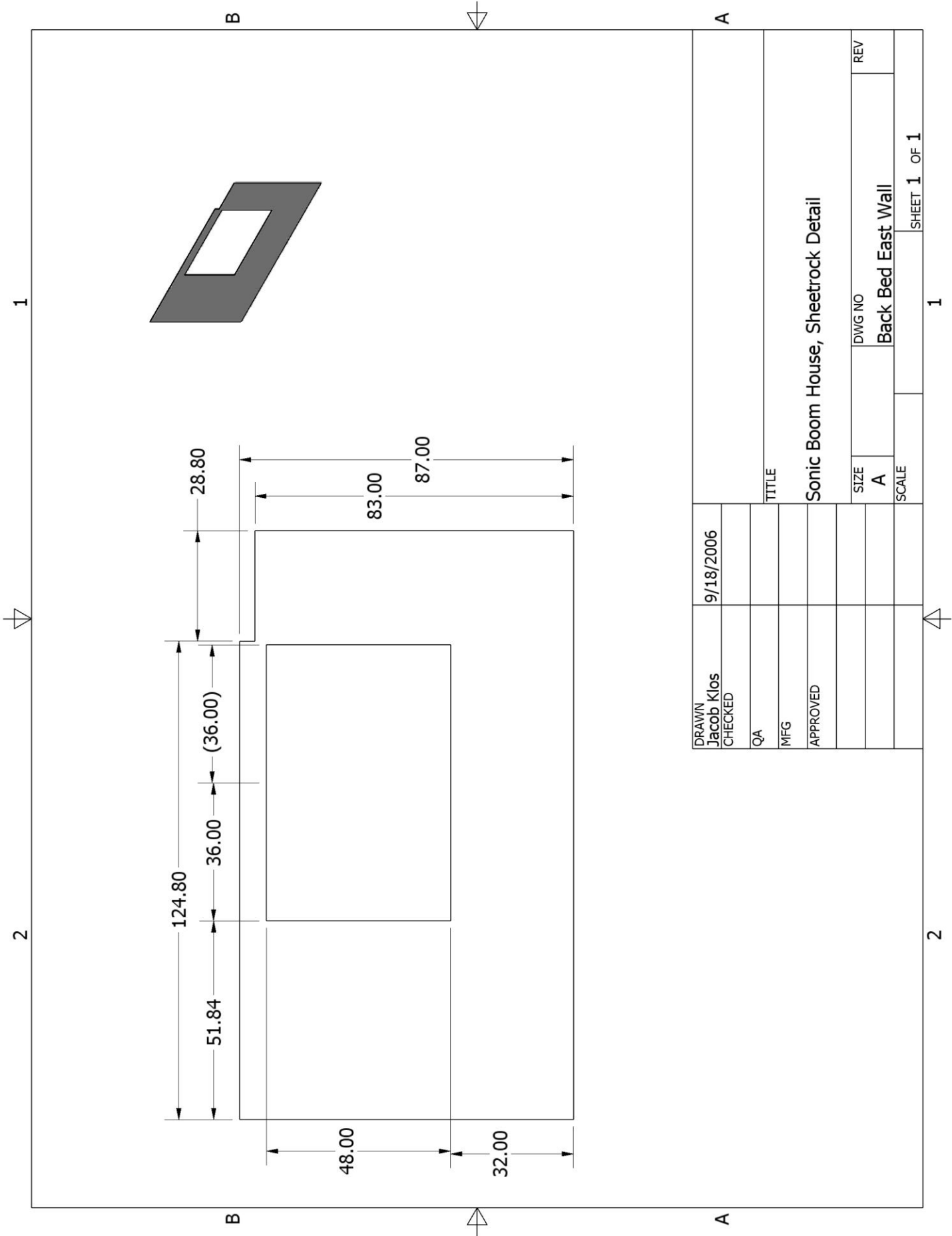
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APPROVED					
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		Back Bed Isometric			
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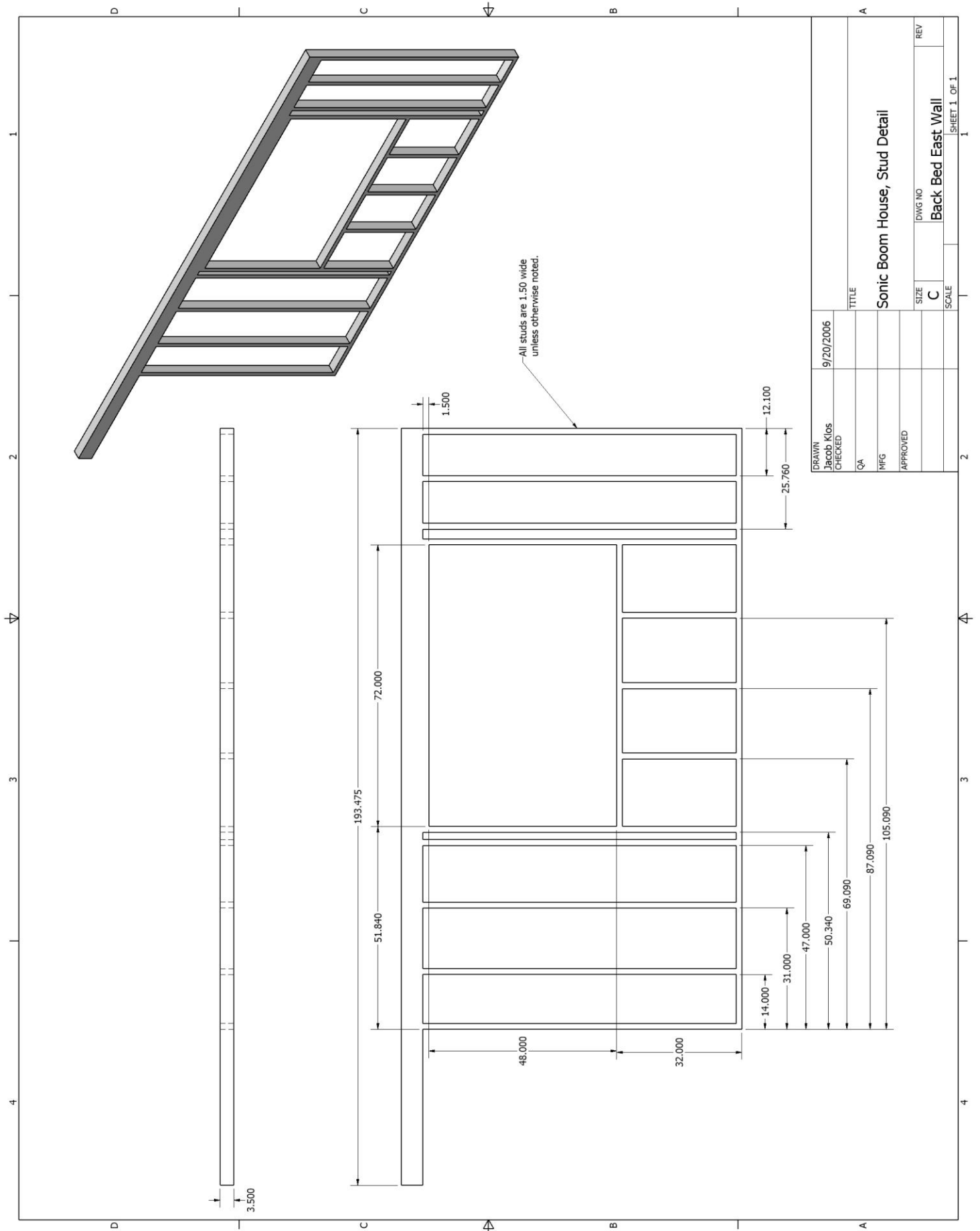
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MFG				
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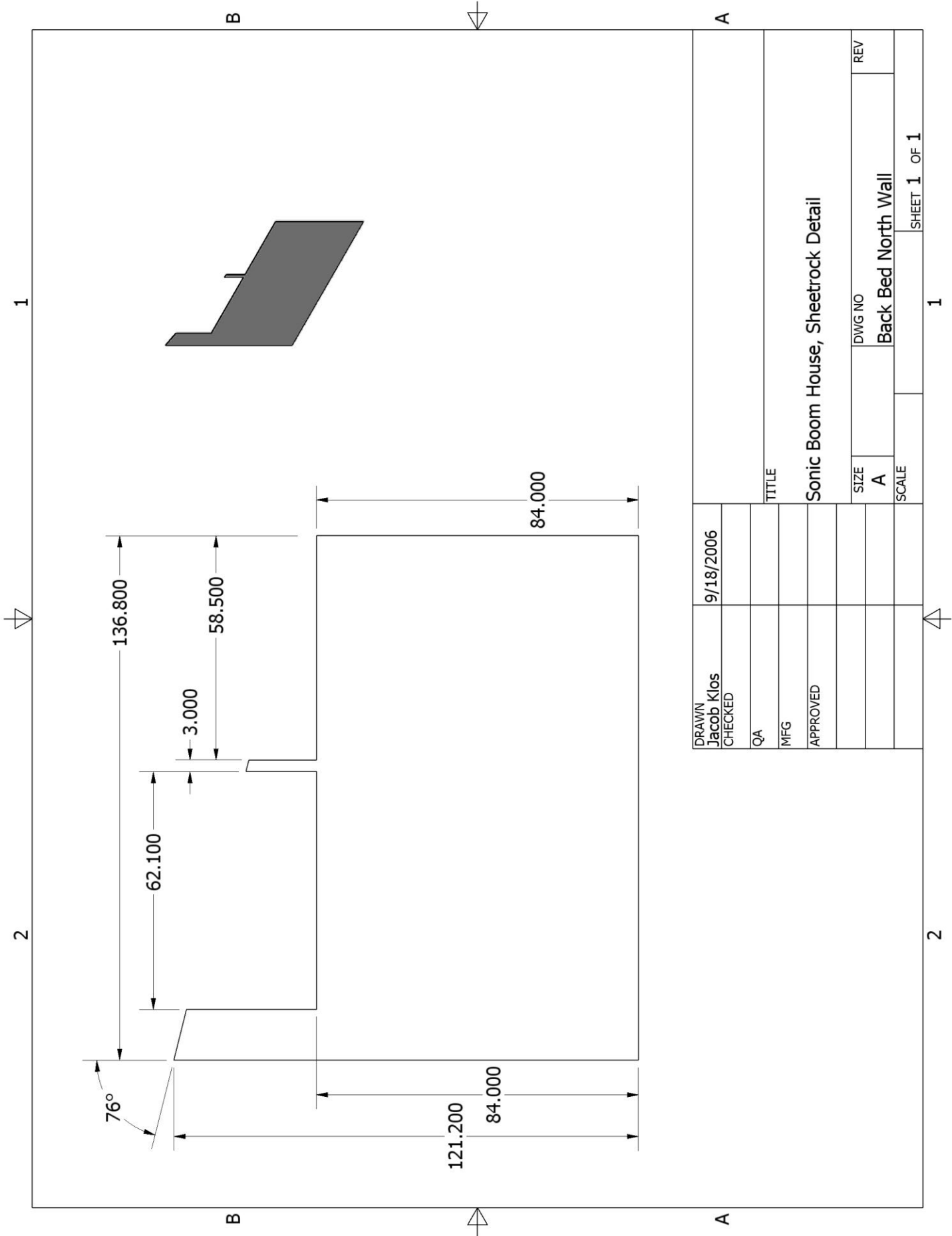
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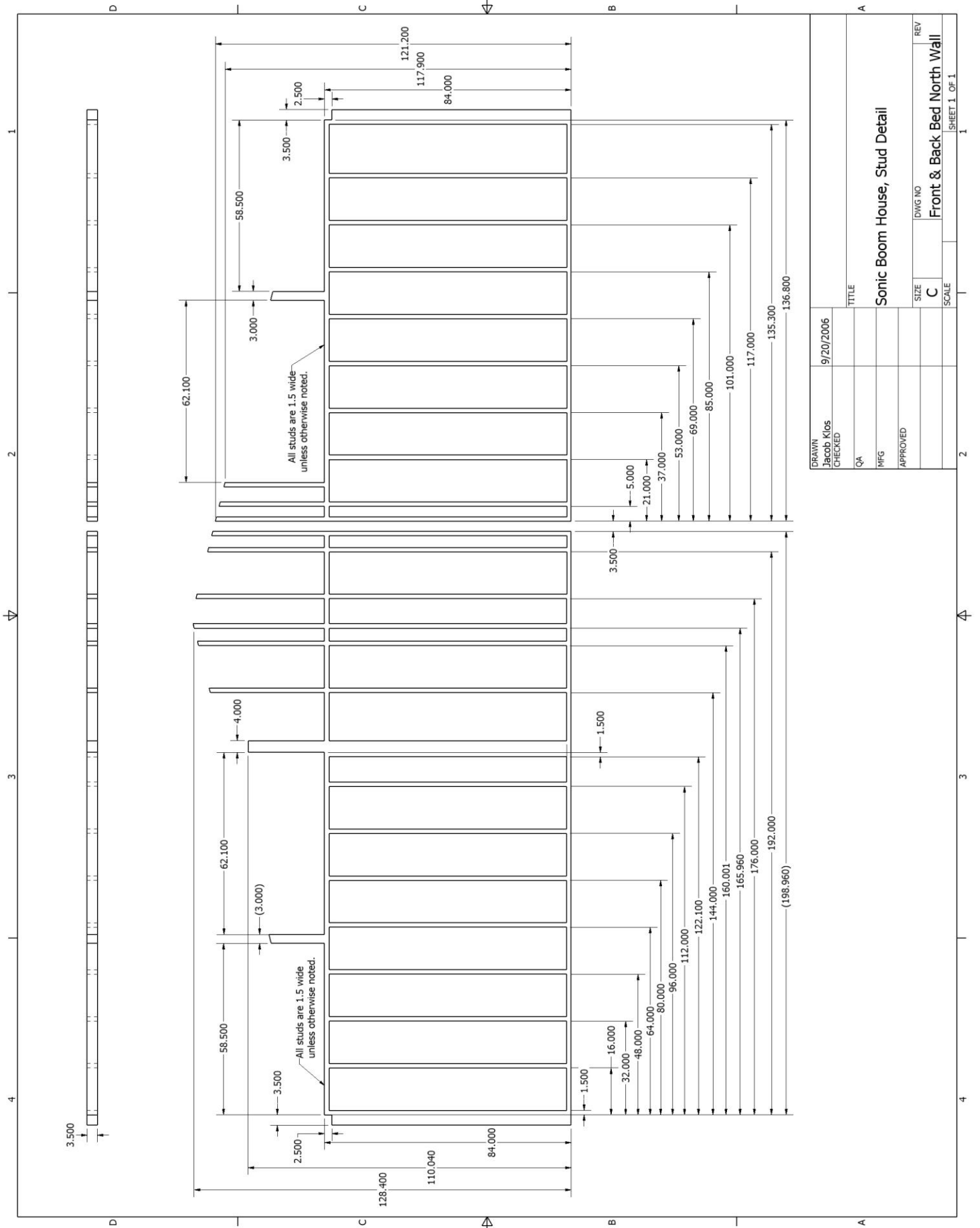
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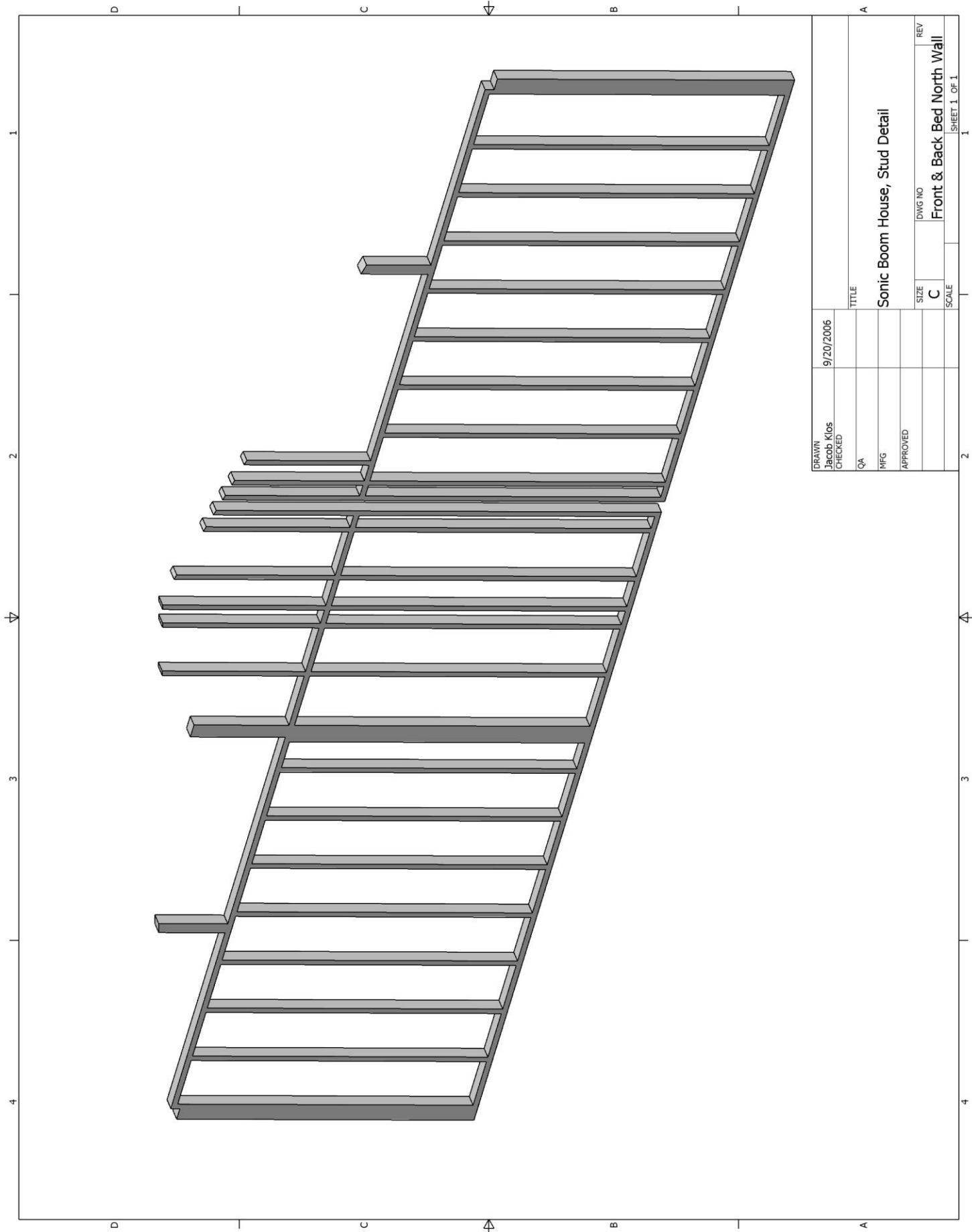
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APPROVED					
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		SCALE	Back Bed East Wall		
			SHEET 1 OF 1		



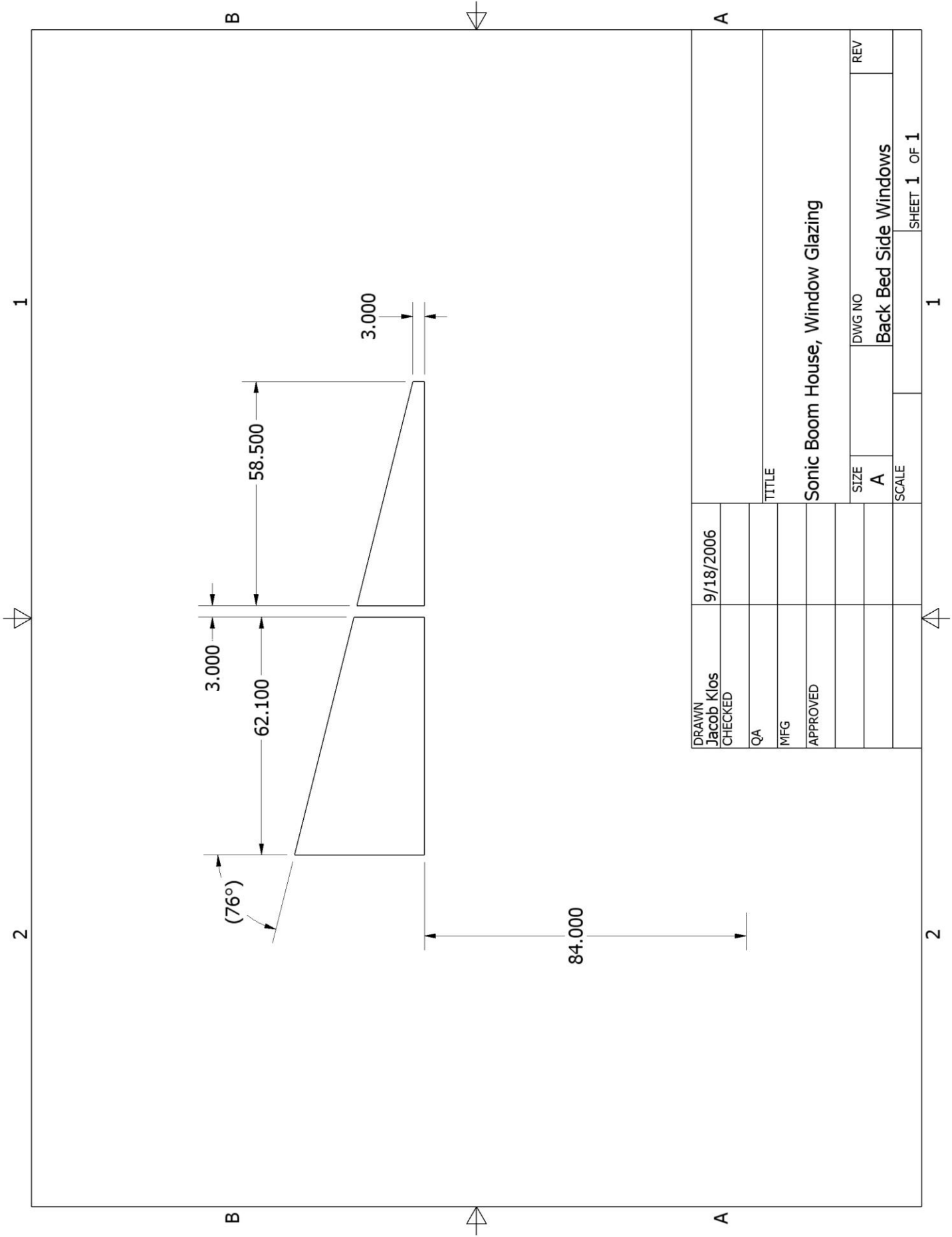




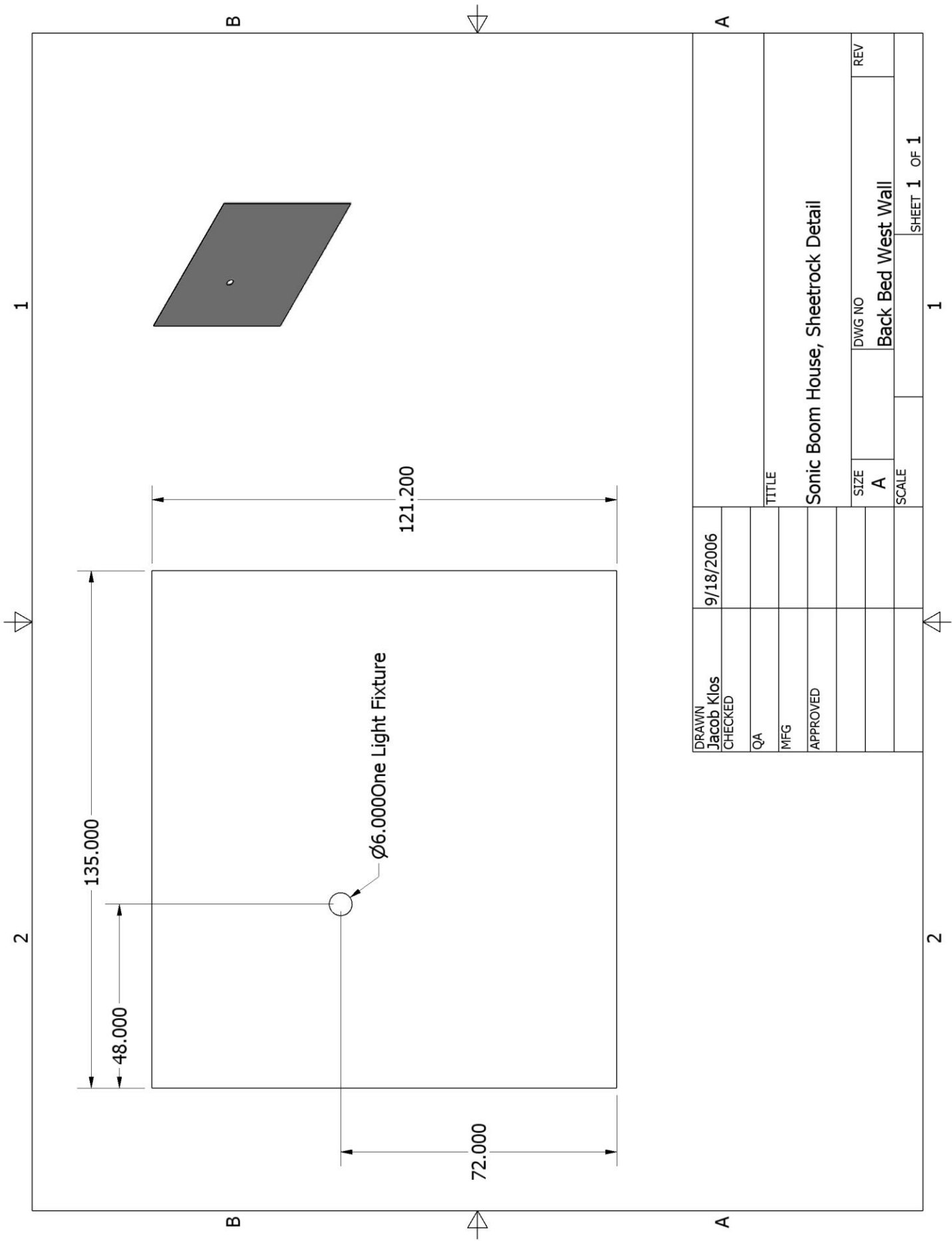
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CHECKED					
QA					
MFG					
APPROVED					
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					Front & Back Bed North Wall
					SHEET 1 OF 1



DRAWN Jacob Klos CHECKED	9/20/2006				
QA		TITLE			
MFG		Sonic Boom House, Stud Detail			
APPROVED		SIZE C	DWG NO	REV	
		SCALE	Front & Back Bed North Wall		
					SHEET 1 OF 1
2					1

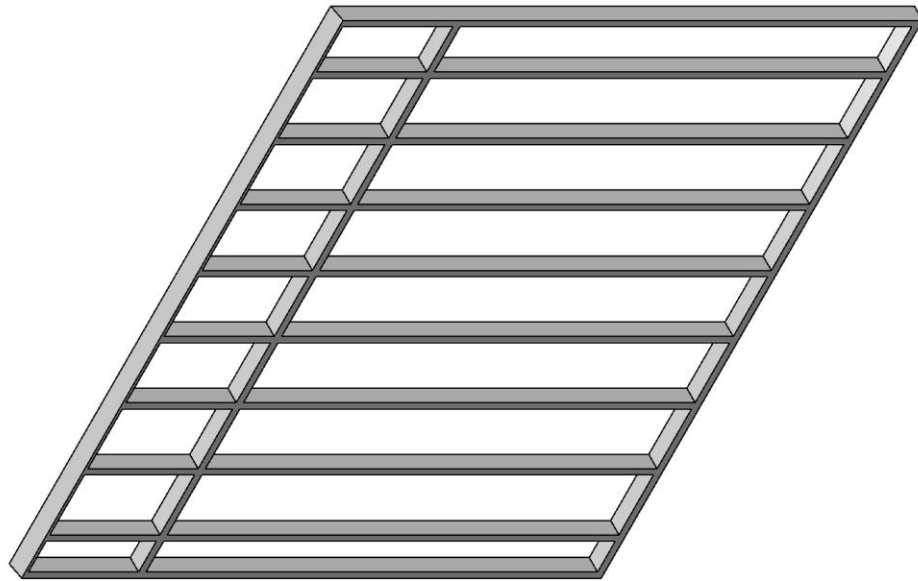


DRAWN Jacob Klos	9/18/2006	TITLE				REV	
CHECKED							
QA							
MFG							
APPROVED							
Sonic Boom House, Window Glazing							
		SIZE		DWG NO			
		A		Back Bed Side Windows			
		SCALE				SHEET 1 OF 1	

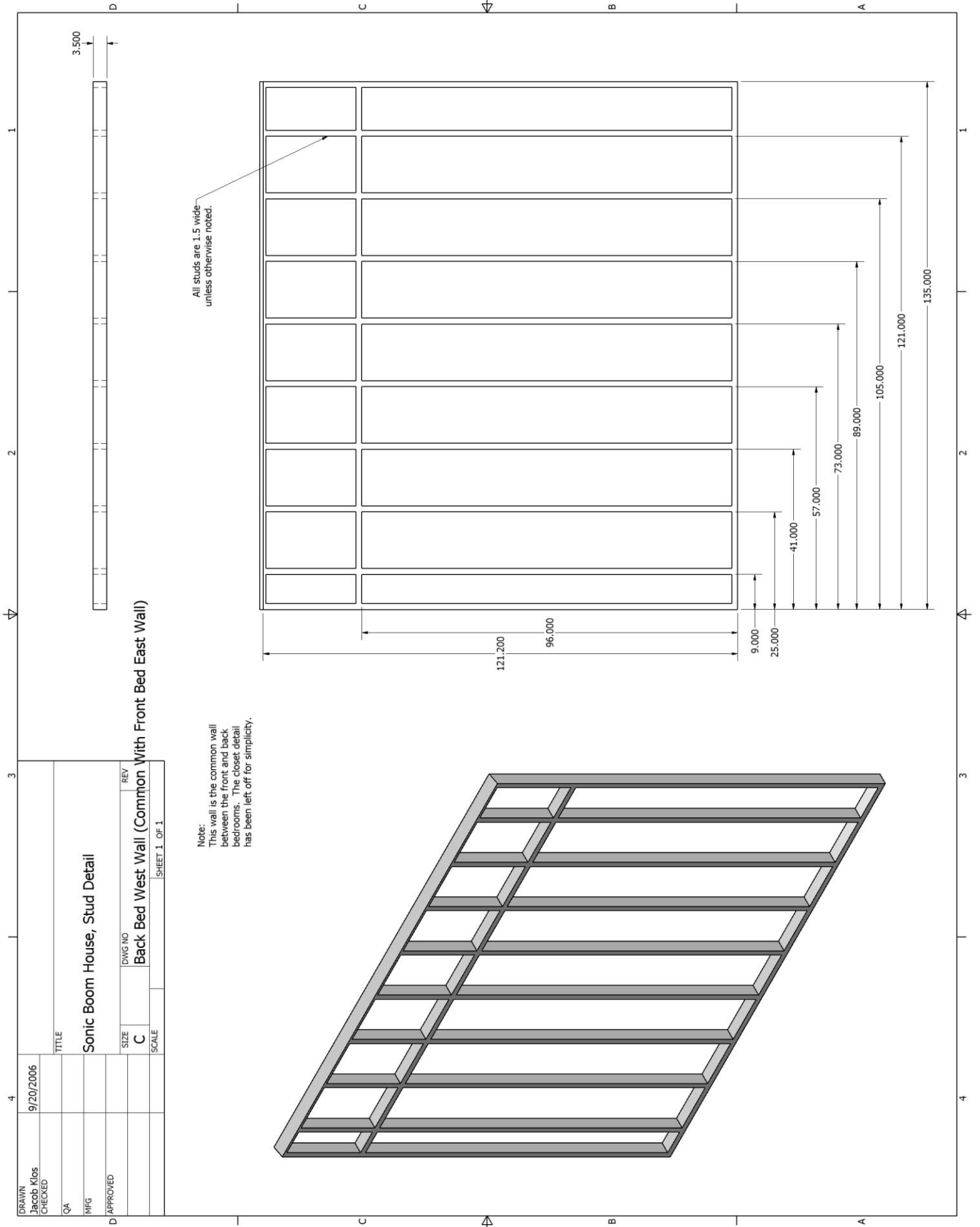


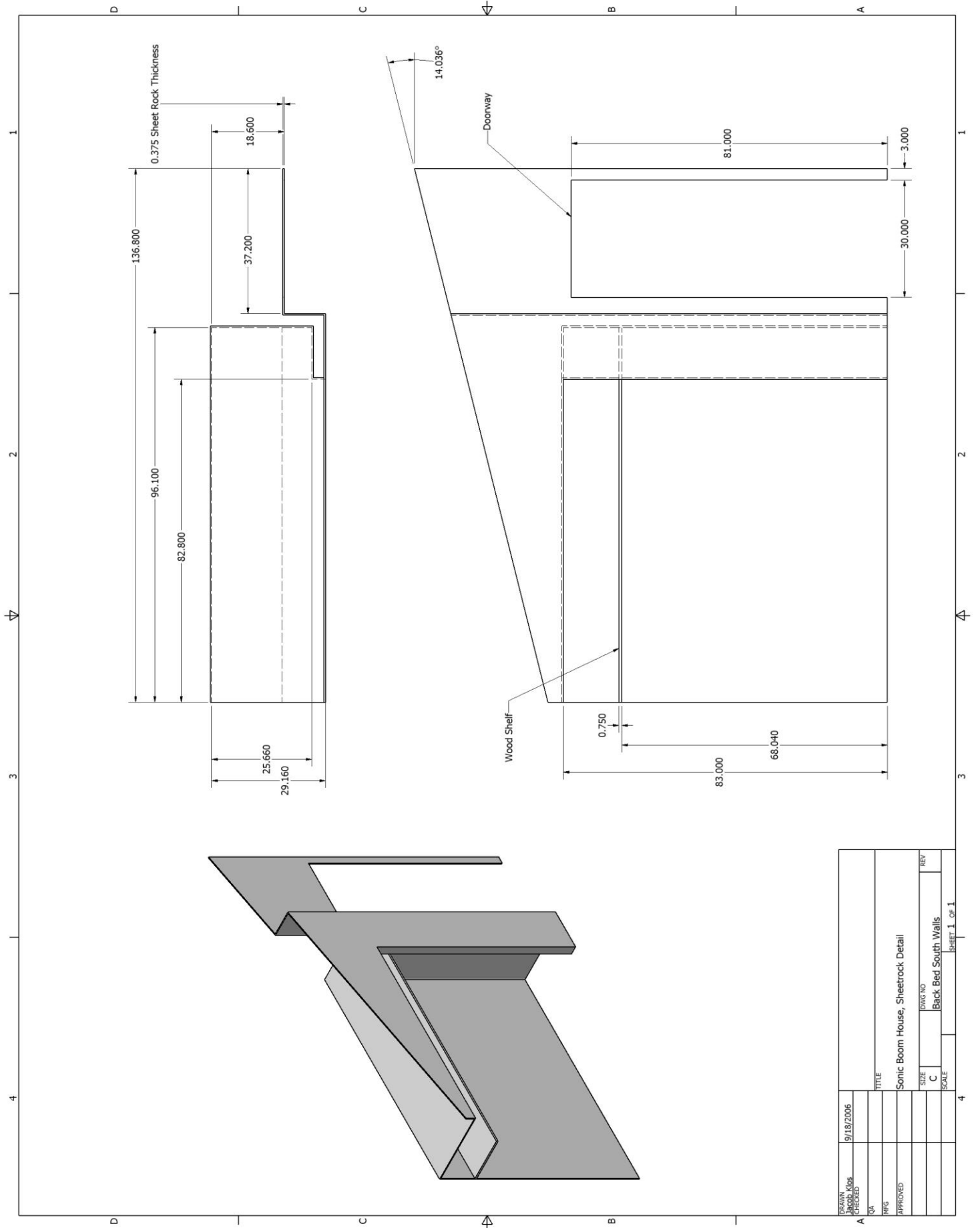
DRAWN Jacob Klos CHECKED		9/20/2006	4		3	
QA			TITLE			
MFG			Sonic Boom House, Stud Detail			
APPROVED						
			SIZE	DWG NO	REV	
			C			
			SCALE	Back Bed West Wall (Common V		
				SHEET 1 OF 1		

Note:
This wall is the common wall
between the front and back
bedrooms. The closet detail
has been left off for simplicity.



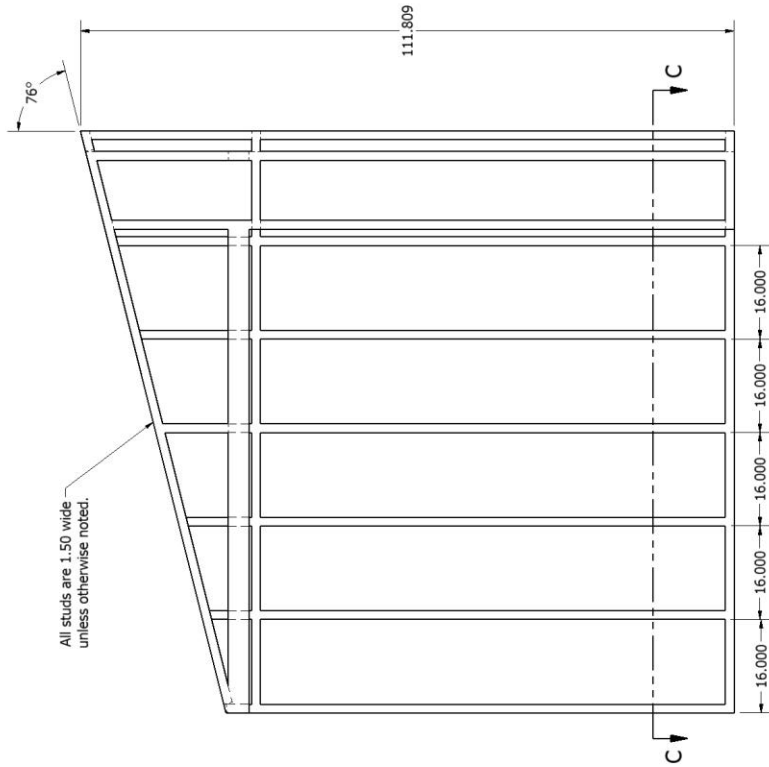
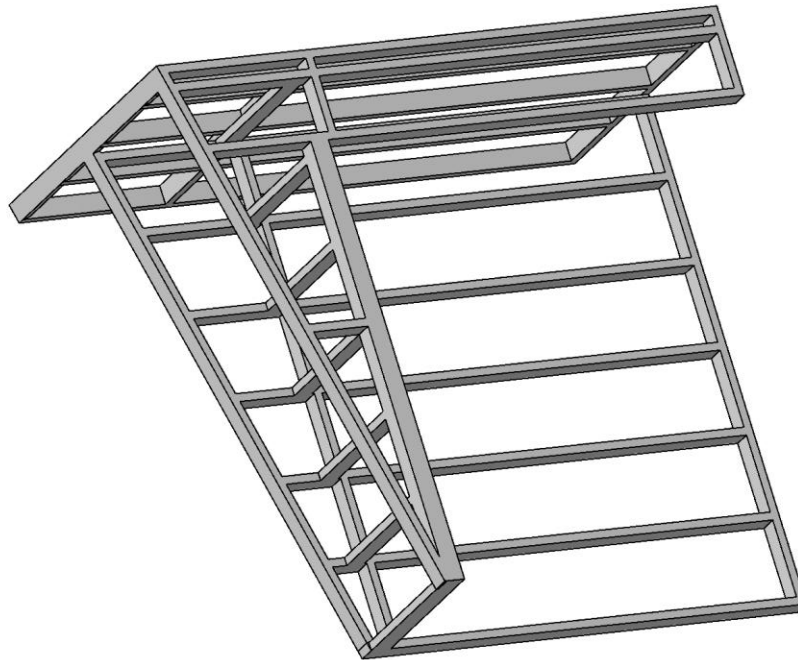
All studs are 1.5 wide
unless otherwise noted.



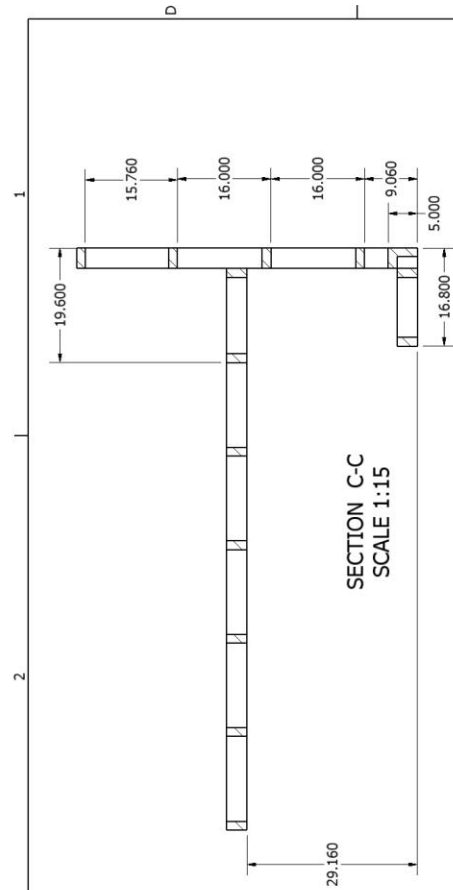


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	CHKD	CA		
	DATE	9/18/2006		
B	APPROVED		Sonic Boom House, Sheetrock Detail	
	DATE			
	BY			
	CHKD			
C	DATE		Back Bed South Walls	
	BY			
	CHKD			
	DATE			
SCALE			SHEET 1 OF 1	

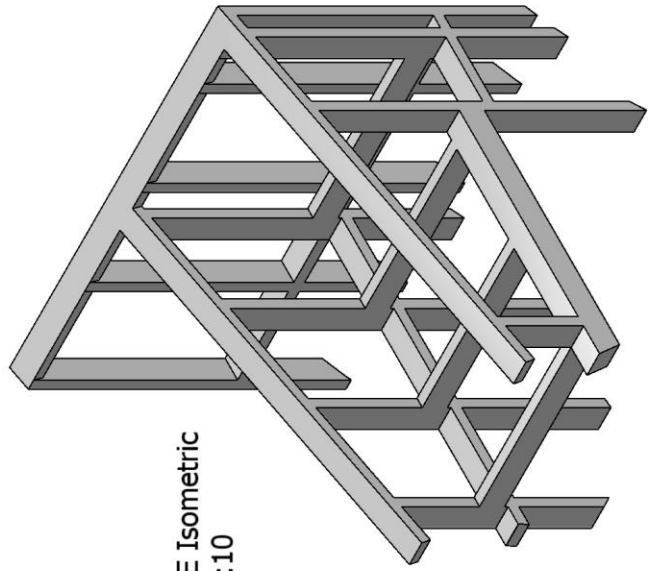
4		3	
DRAWN	9/20/2006	TITLE	
Jacob Klos			
CHECKED			
QA			
MFG			
APPROVED	Sonic Boom House, Stud Detail		
D	SIZE	DWG NO	REV
	C	Back Bed South Wall	
	SCALE	SHEET 1 OF 1	



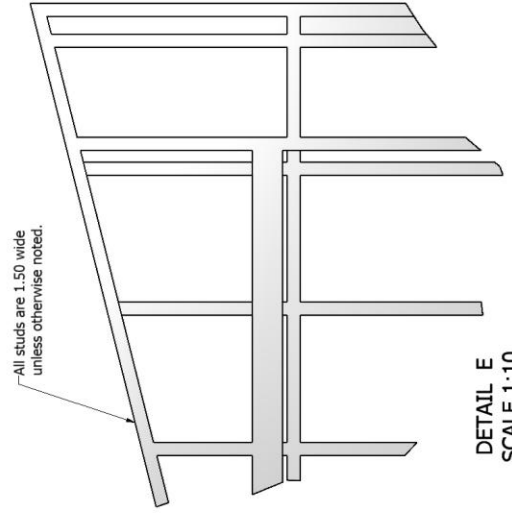
SECTION C-C
SCALE 1:15



DRAWN Jacob Klos CHECKED	9/20/2006		TITLE	
			Sonic Boom House, Stud Detail	
	QA			
	TMFG			
APPROVED			DWG NO	
			Back Bed South Wall (Detailed)	
			REV	
			SHEET 1 OF 1	
D		C		SCALE

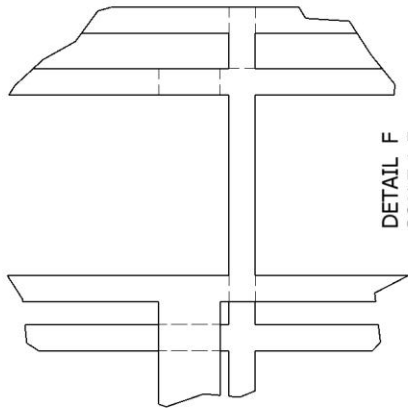


Detail E Isometric
Scale 1:10

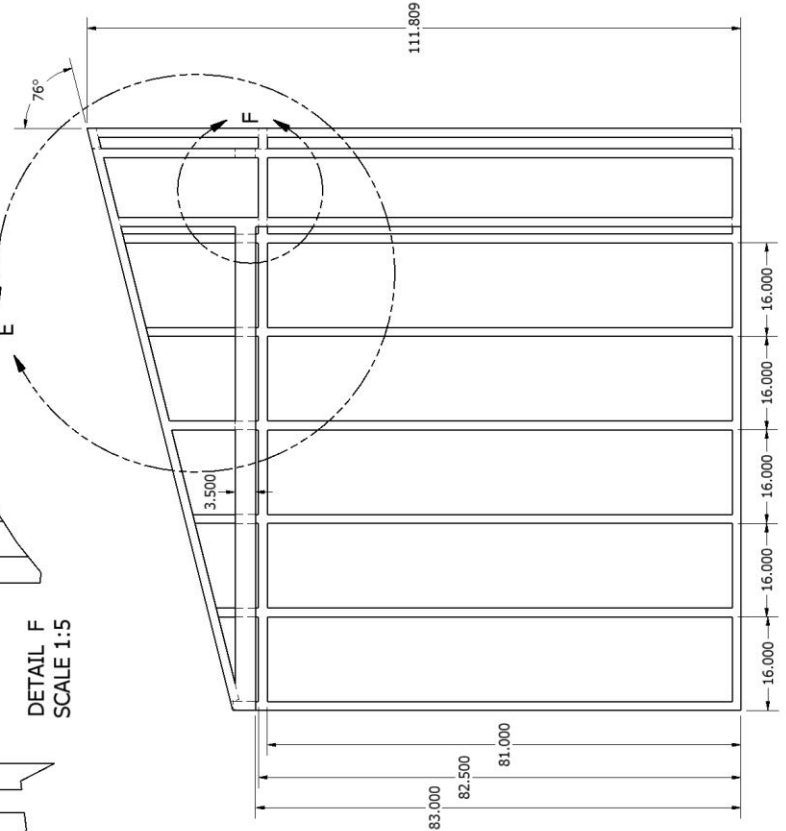


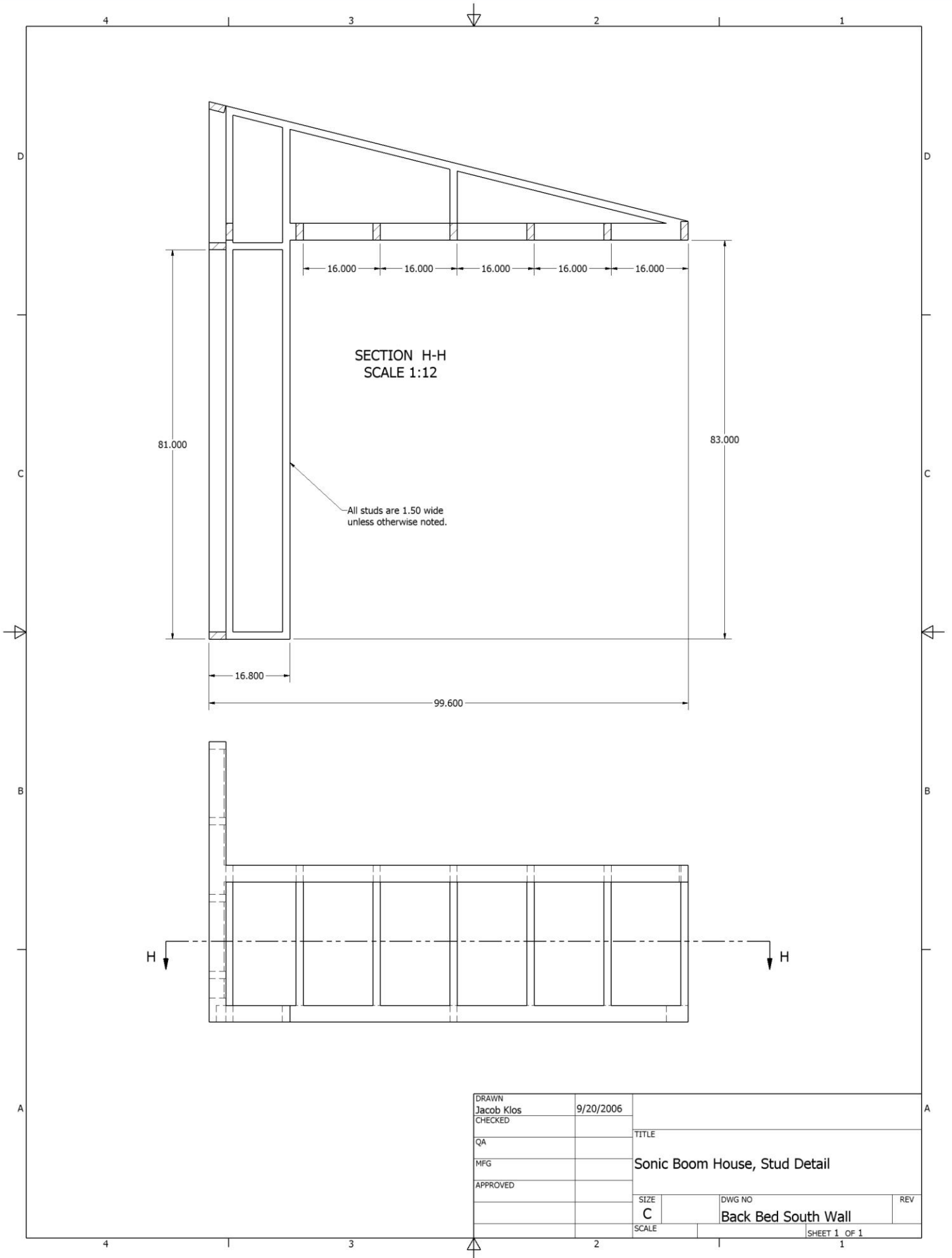
All studs are 1.50 wide unless otherwise noted.

DETAIL E
SCALE 1:10

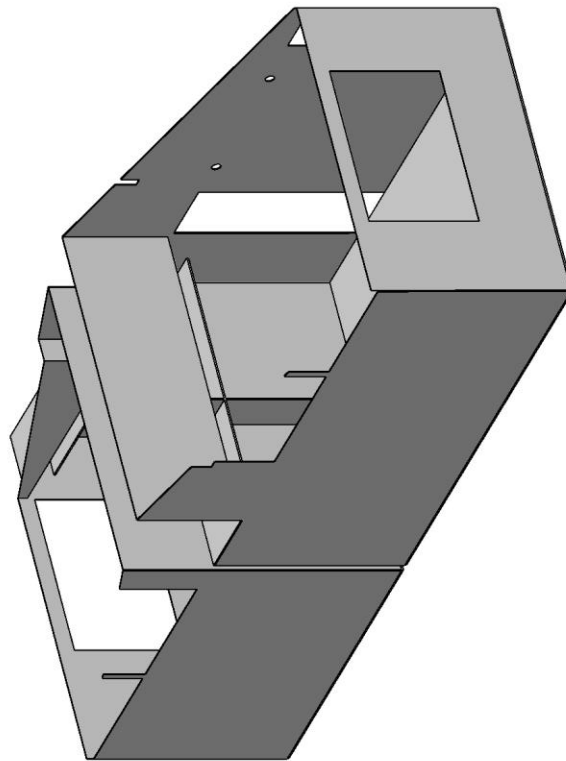
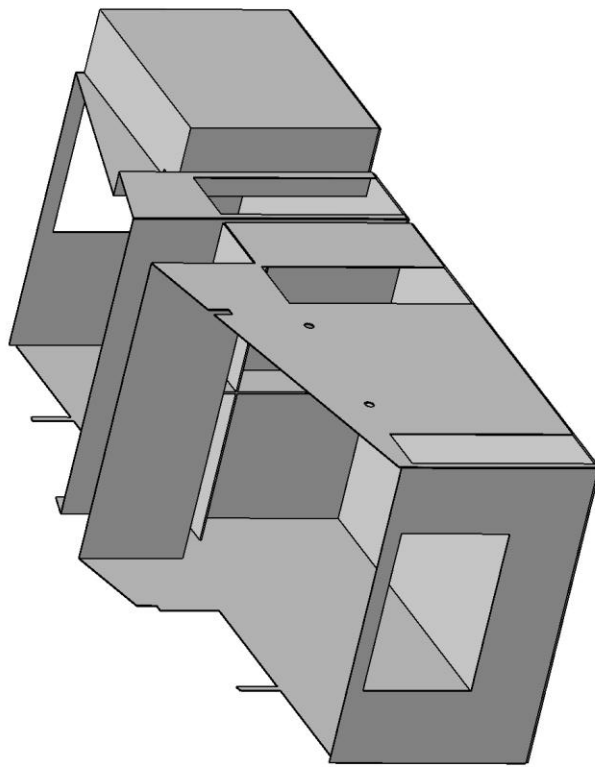


DETAIL F
SCALE 1:5

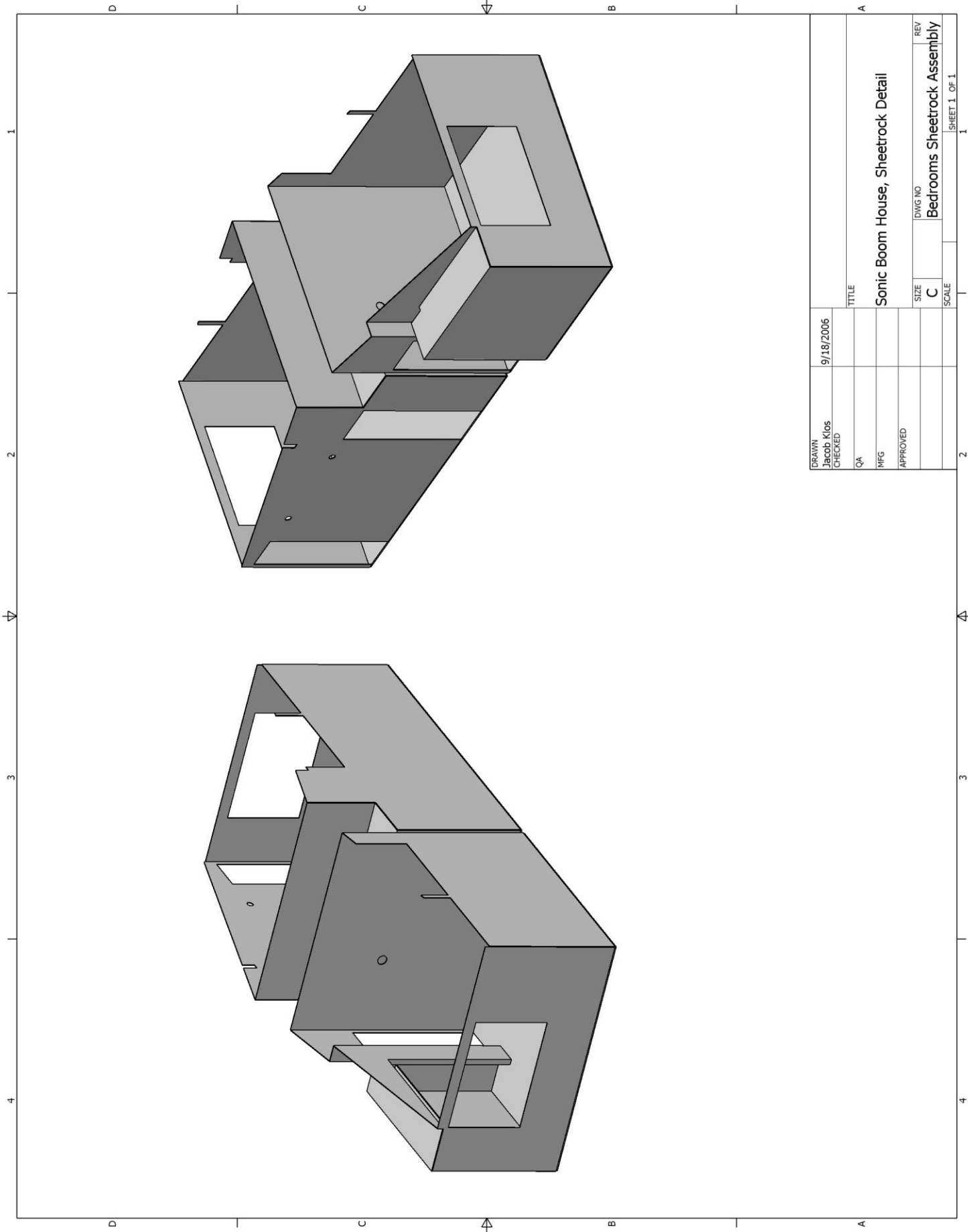




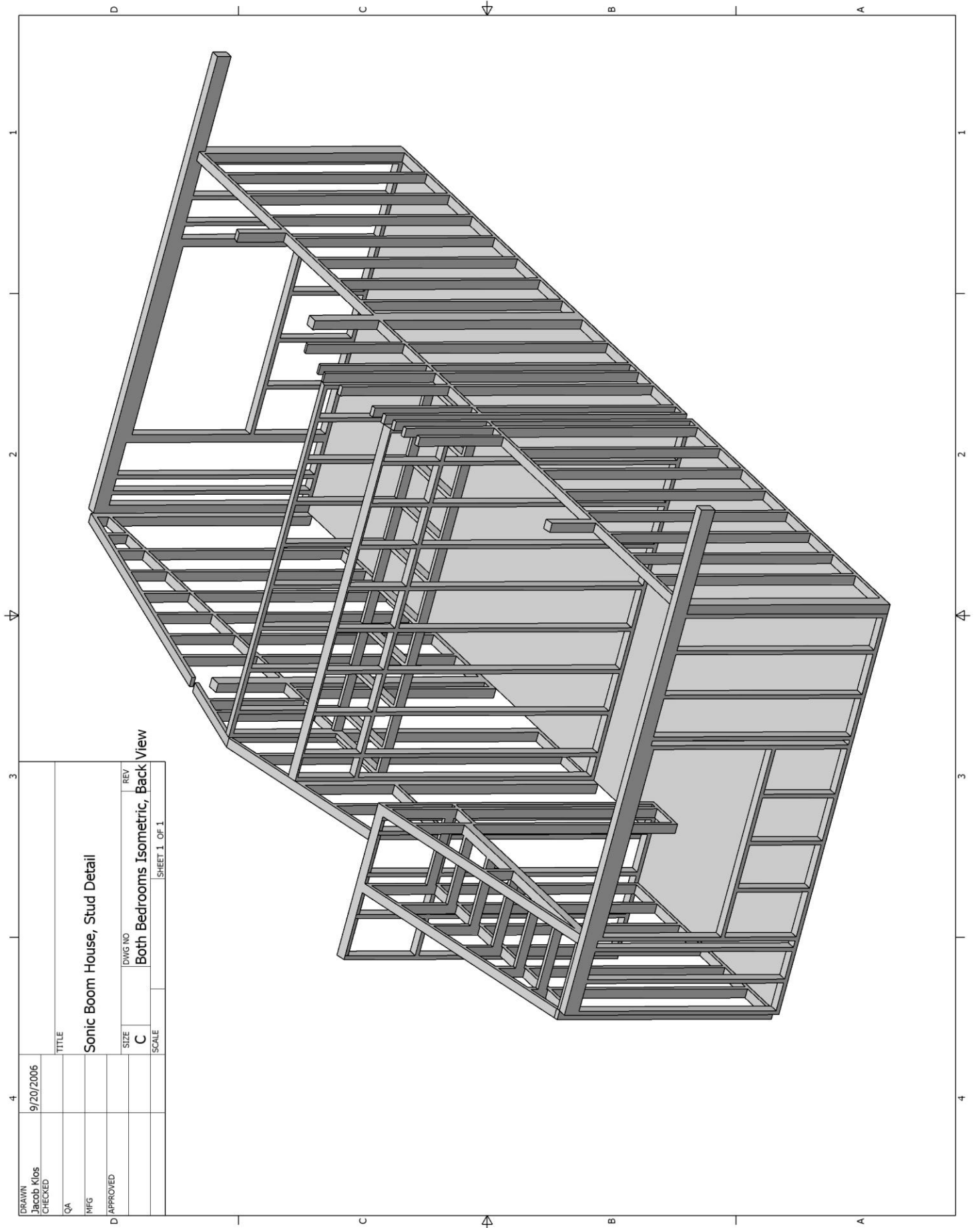
DRAWN Jacob Klos	9/20/2006		
CHECKED		TITLE	
QA		Sonic Boom House, Stud Detail	
MFG			
APPROVED		SIZE C	DWG NO Back Bed South Wall
		SCALE	REV
			SHEET 1 OF 1



DRAWN	9/18/2006				
Jacob Klos					
CHECKED					
QA					
MFG					
APPROVED					
TITLE		Sonic Boom House, Sheetrock Detail			
SIZE	DWG NO	REV			
C			Bedrooms Sheetrock Assembly		
SCALE				SHEET 1 OF 1	
2	1	1			



DRAWN Jacob Klos	9/18/2006	TITLE	
CHECKED		Sonic Boom House, Sheetrock Detail	
QA		Sonic Boom House, Sheetrock Detail	
MFG		Sonic Boom House, Sheetrock Detail	
APPROVED		Sonic Boom House, Sheetrock Detail	
		SIZE C	REV
		DWG NO	Bedrooms Sheetrock Assembly
		SCALE	SHEET 1 OF 1



DRAWN Jacob Klos CHECKED	9/20/2006		TITLE Sonic Boom House, Stud Detail
	QA		
	TMFG		
	APPROVED		
D	SIZE C	DWG NO	REV
	SCALE	Both Bedrooms Isometric, Back View	
		SHEET 1 OF 1	

Appendix B

Drawings and photographs of the house exterior.

(All dimensions are in inches unless otherwise noted)



View of the front of the house.



View of the sidewall of the house.

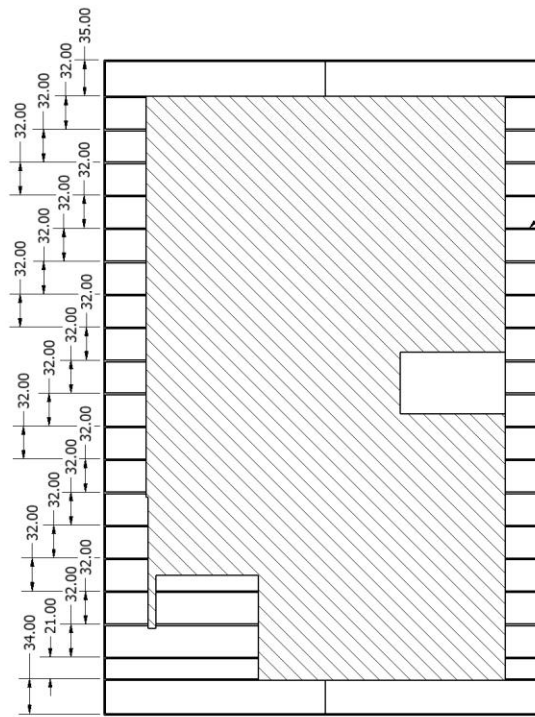
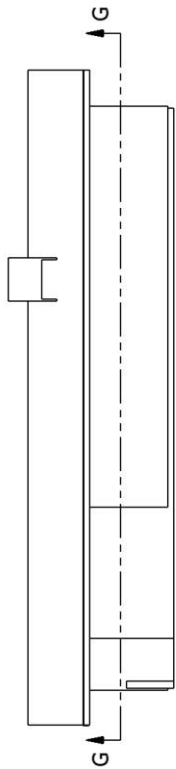


View of the enclosed patio attached to the house.

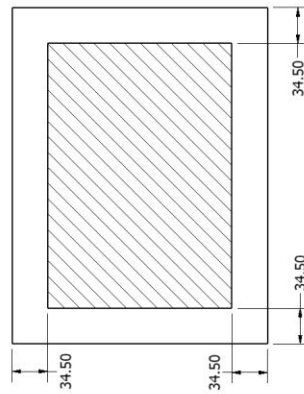


DRAWN	9/20/2006				
Jacob Klos					
CHECKED					
QA		TITLE			
MFG		Sonic Boom House, Exterior Detail			
APPROVED					
		SIZE	DWG NO	REV	
		C			
		House isometric views			
		SCALE			
2		SHEET 1 OF 1			
		1			

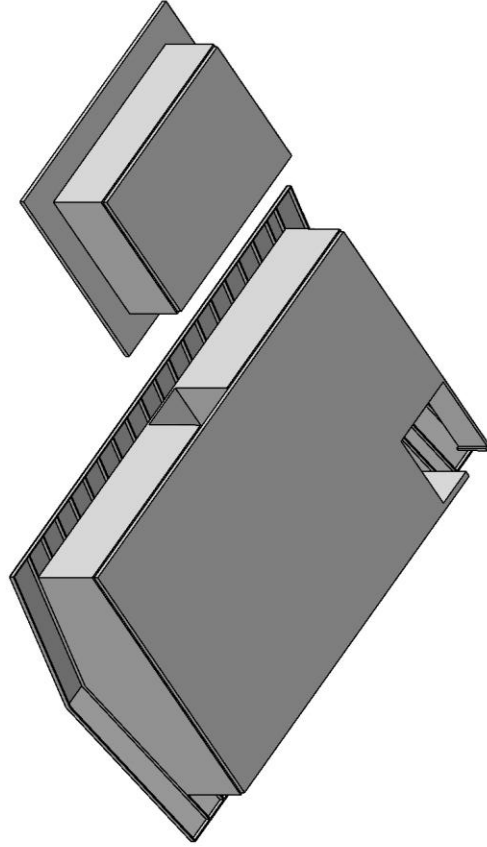




All rafters 1.5 inches wide.



SECTION G-G
SCALE 1 / 85



DRAWN Jacob Klos CHECKED	9/20/2006	TITLE	Sonic Boom House, Exterior Detail		
QA			SIZE	C	REV
MFG			DWG NO		
APPROVED			SCALE		
			Roof Rafters Detail		
			SHEET 1 OF 1		

Appendix C

GPS survey locations.

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY

UNCLASSIFIED

Geospatial Sciences Division
Geodetic Surveys Branch
Edwards AFB, California

Publication 07-1E02
Sonic Boom Test
Edwards AFB, California

November 2006

Know The Earth....Show The Way

UNCLASSIFIED



Sonic Boom Test
Edwards AFB,CA

November 2006

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SURVEY OPERATIONS.	2
DATA REDUCTION	2
GEODETIC DATA	3
SURVEY ACCURACIES	4
COMMENTS	4

DISCLAIMER: The mention herein of commercial products, trade names, or commercial companies does not constitute an endorsement of such products or companies by the United States Government.

UNCLASSIFIED

EAFB: 07-1E02

**Sonic Boom Test
Edwards AFB, CA
November, 2006**

1. INTRODUCTION

This report covers the geodetic survey completed by the National Geospatial-Intelligence Agency (NGA), Edwards Range NGA Support Team, in support of NASA Dryden Low Boom/No Boom project and the AFFTC Hypersonic Flight Test Team. The survey was required to position and provide the orientation of the exterior walls of a house and garage at 7334 Andrews on Edwards AFB, CA. The latitude, longitude, and ellipsoid height are requested to be in the World Geodetic System 1984 (WGS 84), and the orthometric heights in the Earth Gravity Model 1996 (EGM 96) at ground level.

2. GENERAL

a. References: National Geospatial-Intelligence Agency Geospatial Sciences Division's Geodetic Survey Request Worksheet. Memorandum for AFFTC/XPI (Mr. Dave Foster), Request for NGA Survey.

b. Persons Contacted:

Edward A. Haering, Jr.
NASA Dryden Flight Research Center
Edwards AFB, CA
Comm: (661) 276-3696
Cell: (661) 816-9936
Fax: (661) 276-2841
Email: ed.haering@dfrc.nasa.gov

c. Accuracy requirement: The points should be accurate to 0.1 meter, SE, each component, relative to local control and 0.1 meter relative to the local EGM 96 geoid height. The north orientation of the walls should be better than 0.5 degrees from true North.

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EAFB: 07-1E02

3. SURVEY OPERATIONS

a. On October 31, 2006 a three man team deployed to 7334 Andrews on Edwards AFB, CA to survey each of the exterior walls of the house and the garage. There are five points on the house (**34NE**, **34SE**, **34NW**, **34SW**, and **34SE1**) and four points on the garage (**G4NE**, **G4SE**, **G4NW**, and **G4SW**). A 6-inch nail was driven through the roof at each of the corners of the buildings and used as the point of survey. Trimble MSGR 4000 GPS receivers were used to survey these points on the roof tops. The Edwards main control station **UNO 1997** and **Master North Base 1955** were used as the primary control for the local control points, **PG01** and **PG02**, and two two-hour static sessions were observed with a change in the height of the antenna between sessions. The PG points were then used to position the points on the roof tops of each building and minimum of two thirty-minute static sessions were observed on each of these points with a change in the height of the antenna between sessions. Survey point **34SE1** was positioned from tape measured distances due to signal interference from large trees overhanging the building.

b. Team members: Ken Bennett, Bill Pressley, and Dave Kanavel.

4. DATA REDUCTION

Static GPS: The data collected through static GPS methods were post processed using Trimble GPSurvey software which produced differential vectors. The derived differential vectors were then adjusted using GeoLab 3 three-dimensional least squares adjustment software. Station **UNO 1997** was held fixed in the control adjustment, that established **PG01** and **PG02** as local control for the rest of the survey, and the coordinates for **MASTER NORTH BASE 1955** were used as a quality control check on the published position. Station **PG02** was then held fixed in the local adjustment with **PG01** as a check on the previously established position.

5. GEODETIC DATA

a. The WGS 84 latitude and longitude are in degrees, minutes, and seconds. The WGS 84 ellipsoid heights and EGM 96 orthometric heights are in meters.

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EAFB: 07-1E02

STATION NAME	LATITUDE (WGS 84)	LONGITUDE (WGS 84)	ELLIPSOID (WGS 84)	ORTHOMETRIC (EGM 96)
34NE	N 34 55 55.27786	W117 56 24.47053	688.025m	720.092m
34NW	N 34 55 55.30857	W117 56 24.81947	687.938m	720.005m
34SE	N 34 55 54.89807	W117 56 24.52088	688.099m	720.166m
34SE1	N 34 55 54.81457	W117 56 24.53267	688.120m	720.187m
34SW	N 34 55 54.84519	W117 56 24.88138	688.012m	720.079m
G4NE	N 34 55 55.06646	W117 56 24.96792	688.005m	720.072m
G4NW	N 34 55 55.08297	W117 56 25.14546	687.909m	719.976m
G4SE	N 34 55 54.85671	W117 56 24.99599	688.046m	720.113m
G4SW	N 34 55 54.87331	W117 56 25.17421	687.992m	720.059m

b. The following azimuths are in arc degrees and minutes and are referenced to true North.

FROM STATION	TO STATION	AZIMUTH	DISTANCE
34SE1	34NE	006 18	14.366m
34NE	34SE1	186 18	14.366m
34NE	34NW	276 05	8.907m
34NW	34NE	096 05	8.907m
34NW	34SW	186 16	14.368m
34SW	34NW	006 16	14.368m
34SW	34SE1	096 05	8.902m
34SE1	34SW	276 05	8.902m
G4NE	G4NW	276 26	4.536m
G4NW	G4NE	096 26	4.536m
G4NW	G4SW	186 26	6.503m
G4SW	G4NW	006 26	6.503m
G4SW	G4SE	096 27	4.553m
G4SE	G4SW	276 27	4.553m

6. SURVEY ACCURACIES

a. WGS 84 Geodetic Positions: The survey is accurate to 0.025 meter, SE, relative to local WGS 84 (G1150) control, **UNO 1997**. The G1150 reference system is the latest NGA realization of WGS 84 that is coincident with the International Earth Rotation Service's (IERS) Terrestrial Reference Frame 2000 (ITRF00).

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EAFB: 07-1E02

b. Orthometric Heights: The accuracy is estimated to be 0.025 meter, SE, relative to the local Earth Gravity Model 1996 (EGM96) from station **UNO 1997**. The orthometric heights given in this publication are representative of mean sea level (MSL). The term mean sea level implies orthometric height. In actuality, these elevations are relative to a vertical datum (EGM96) that approximates mean sea level and are correctly referred to as orthometric heights.

c. True North Azimuths: The azimuths are accurate to 30 arc minutes.

7. COMMENTS

If you have any questions or concerns about this project, please contact Neal Thompson or Kenneth Bennett at (661) 277-5050.

Prepared by: Kenneth P.D Bennett
Geometric Geodesist

Neal L. Thompson
Chief, Edwards Range
NGA Support Team

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Appendix D

Transducer and data acquisition equipment specification sheets.

(These specifications are an abridged version contained on the manufacturers' specification sheets, sheets or information not contained in this appendix may be available upon request)

Pistonphone type 4228**Satisfied standards**

IEC 942 (1988) Class 1L (Class 0L with suitable external barometer)

ANSI S1.40-1984

Nominal sound pressure level

	124 dB re 20 mPa –0.2 dB at reference conditions:
Ambient Pressure	1013 hPa
Ambient Temperature	20 C (68 F)
Ambient Humidity	65%RH
Effective Load Volume	1.333 cm ³

Frequency

Nominal	250Hz
Actual	251.2 Hz –0.1%

Individual calibration accuracy

At Reference Conditions	–0.09 dB
At Ambient Reference Conditions	–0.12 dB with specified microphone types
Within Range of Ambient Conditions	
With External Barometer	–0.15 dB — IEC 942 (1988) Class 0L
With Included Barometer	–0.30 dB — IEC 942 (1988) Class 1L

Nominal effective coupler volume

19.733 cm³ (at 250Hz) including Nominal Effective Load
Volume 1.333 cm³

Total harmonic distortion <3%

Ambient conditions**Ranges**

Pressure	650 hPa to 1080 hPa
Temperature	–10 to +50 C (14 to 122 F)
Relative Humidity	5% RH to 95%RH
Required Measurement Accuracy	
Pressure	–0.3% (IEC 942 Class 0L) –2.0% (IEC 942 Class 1L)
Temperature	–5 C
Relative Humidity	–15% above 35 C (95 F) (measurement is not necessary below 35 C (95 F))
Ambient Pressure	SPL is proportional to the ambient pressure (correction read from the barometer supplied)
Ambient Temperature	–0.0005 dB/ C (estimated)
Ambient Humidity	–0.0001 dB/%RH at the reference conditions

Accelerometer Calibrator 394C06**Performance**Operating Frequency (± 1 %)Acceleration Output (± 3 %)

Velocity Output

Displacement Output

Transverse Output

Distortion (0 to 100 grams load)

Distortion (100 to 210 grams load)

Maximum Load

Environmental

Temperature Range (Operating)

SI

159.2 Hz

1.00 g rms

9.81 mm/s rms

9.81 μ m rms ≤ 3 % ≤ 2 % ≤ 3 %

210 gm

-10 to +55 °C

Accelerometer Model 333B32**Performance**

Sensitivity ($\pm 10\%$)
 Measurement Range
 Frequency Range ($\pm 5\%$)
 Resonant Frequency
 Phase Response ($\pm 5^\circ$)
 Broadband Resolution (1 to 10 kHz)
 Non-Linearity
 Transverse Sensitivity

Environmental

Overload Limit (Shock)
 Temperature Range (Operating)
 Base Strain Sensitivity

Electrical

Excitation Voltage
 Constant Current Excitation
 Output Impedance
 Output Bias Voltage
 Discharge Time Constant
 Spectral Noise (10 Hz)
 Spectral Noise (100 Hz)
 Spectral Noise (1 kHz)

Physical

Sensing Element
 Sensing Geometry
 Housing Material
 Sealing
 Size (Length x Width)
 Weight
 Electrical Connector
 Electrical Connection Position
 Mounting

SI

10.2 mV/(m/s²)
 ± 490 m/s² pk
 0.5 to 3000 Hz
 ≥ 40 kHz
 2 to 3000 Hz
 0.0015 m/s² rms
 $\leq 1\%$
 $\leq 5\%$

± 49000 m/s² pk
 -18 to +66 °C
 0.1 (m/s²)/ $\mu\epsilon$

18 to 30 VDC
 2 to 20 mA
 ≤ 300 ohm
 7 to 12 VDC
 1.0 to 3.0 sec
 110 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$
 33 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$
 14 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$

Ceramic
 Shear
 Titanium
 Hermetic
 16.0 mm x 10.2 mm
 4.0 gm
 10-32 Coaxial Jack
 Side
 Adhesive

Accelerometer Model 333B42**Performance**

Sensitivity ($\pm 10\%$)
 Measurement Range
 Frequency Range ($\pm 5\%$)
 Resonant Frequency
 Phase Response ($\pm 5^\circ$)
 Broadband Resolution (1 to 10 kHz)
 Non-Linearity
 Transverse Sensitivity

Environmental

Overload Limit
 Temperature Range
 Base Strain Sensitivity

Electrical

Excitation Voltage
 Constant Current Excitation
 Output Impedance
 Output Bias Voltage
 Discharge Time Constant
 Spectral Noise (10 Hz)
 Spectral Noise (100 Hz)
 Spectral Noise (1 kHz)

Physical

Sensing Element
 Sensing Geometry
 Housing Material
 Sealing
 Size (Length x Width)
 Weight
 Electrical Connector
 Electrical Connection Position
 Mounting

SI

51.0 mV/(m/s²)
 ± 98 m/s² pk
 0.5 to 3000 Hz
 ≥ 20 kHz
 2 to 3000 Hz
 0.0005 m/s² rms
 $\leq 1\%$
 $\leq 5\%$

± 49000 m/s² pk
 -18 to +66 °C
 0.1 (m/s²)/ $\mu\epsilon$

18 to 30 VDC
 2 to 20 mA
 ≤ 200 ohm
 7 to 12 VDC
 1.0 to 2.5 sec
 37 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$
 11 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$
 3.9 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$

Ceramic
 Shear
 Titanium
 Hermetic
 17.3 mm x 11.4 mm
 7.5 gm
 10-32 Coaxial Jack
 Side
 Adhesive

Accelerometer Model 333B52**Performance**

Sensitivity ($\pm 10\%$)
 Measurement Range
 Frequency Range ($\pm 5\%$)
 Resonant Frequency
 Phase Response ($\pm 5^\circ$)
 Broadband Resolution (1 to 10 kHz)
 Non-Linearity
 Transverse Sensitivity

Environmental

Overload Limit
 Temperature Range
 Base Strain Sensitivity

Electrical

Excitation Voltage
 Constant Current Excitation
 Output Impedance
 Output Bias Voltage
 Discharge Time Constant
 Spectral Noise (10 Hz)
 Spectral Noise (100 Hz)
 Spectral Noise (1 kHz)

Physical

Sensing Element
 Sensing Geometry
 Housing Material
 Sealing
 Size (Length x Width)
 Weight
 Electrical Connector
 Electrical Connection Position
 Mounting

SI

102 mV/(m/s²)
 ± 49 m/s² pk
 0.5 to 3000 Hz
 ≥ 20 kHz
 2.5 to 3000 Hz
 0.0005 m/s² rms
 $\leq 1\%$
 $\leq 5\%$

± 39000 m/s² pk
 -18 to +66 °C
 0.1 (m/s²)/ $\mu\epsilon$

18 to 30 VDC
 2 to 20 mA
 ≤ 500 ohm
 7 to 12 VDC
 0.7 to 2.0 sec
 37 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$
 11 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$
 3.9 ($\mu\text{m/s}^2$)/ $\sqrt{\text{Hz}}$

Ceramic
 Shear
 Titanium
 Hermetic
 17.3 mm x 11.4 mm
 7.5 gm
 10-32 Coaxial Jack
 Side
 Adhesive

Accelerometer Model 2250a-10**Performance**

Sensitivity ($\pm 10\%$)
 Measurement Range
 Frequency Range (± 1 dB)
 Resonant Frequency
 Phase Response
 Broadband Resolution
 Non-Linearity
 Transverse Sensitivity

Environmental

Overload Limit
 Temperature Range
 Base Strain Sensitivity

Electrical

Excitation Voltage
 Constant Current Excitation
 Output Impedance
 Output Bias Voltage
 Discharge Time Constant
 Spectral Noise (10 Hz)
 Spectral Noise (100 Hz)
 Spectral Noise (1 kHz)

Physical

Sensing Element
 Sensing Geometry
 Housing Material
 Sealing
 Size (Length x Width)
 Weight
 Electrical Connector
 Electrical Connection Position
 Mounting

SI

10 mV/g
 ± 500 g pk
 2 to 15000 Hz
 ≥ 80 kHz
 Unknown
 Unknown
 $\leq 1\%$
 $\leq 5\%$

± 2000 g pk
 -55 to $+125$ °C
 0.0004 g/ $\mu\epsilon$

18 to 24 VDC
 2 to 10 mA
 ≤ 100 ohm
 8.5 to 11.5 VDC
 3 sec
 Unknown
 Unknown
 Unknown

Ceramic
 Shear
 Plastic
 Epoxy Sealed, non-hermetic
 about 7 mm x 4 mm
 0.4 gm
 1.2 UNM threads
 Side
 Adhesive

Microphone Model Brüel and Kjær Type 4193

Open-circuit sensitivity (250Hz):

–38 dB –1.5dB re 1 V/Pa, 12.5mV/Pa

–54dB –1.5dB re 1V/Pa, 1.8mV/Pa with UC0211

Polarization voltage (external): 200 V

Frequency response:

Pressure-field response:

0.12 Hz to 7 kHz –1dB

0.07 Hz to 20 kHz –2dB

0.13 Hz to 20 kHz –2 dB with UC 0211

In accordance with ANSI S1.4 – 1983, Type 1 and ANSI S1.12, Type M

Lower limiting frequency (–3 dB)	0.01 Hz to 0.05 Hz (vent exposed to sound)
Pressure equalization vent	Side vented
Diaphragm resonance frequency	23 kHz (90 phase shift)
Capacitance (polarized, 250Hz)	18 pF
Equivalent air volume (101.3 kPa)	8.8mm ³
Calibrator load volume (250 Hz)	190mm ³
Pistonphone 4228 correction (with DP 0776)	+0.02 dB
Cartridge thermal noise	19.0 dB (A), 21.3 dB (Lin.)
Upper limit of dynamic range (3% dist)	>162 dB SPL
Maximum sound pressure level	171 dB (peak)

Environmental

Operating temperature range	–30 to +150 C (–22 to +302 F)
(can be used up to +300 C (572 F), but with a permanent sensitivity change of typically +0.4 dB which stabilises after one hour)	
Operating humidity range	0 to 100% RH (without condensation)
Storage temperature	–30 to +70 C (–22 to +158 F)
Temperature coefficient (250 Hz)	–0.002 dB/ C (for the range –10 to +50 C)
Pressure coefficient (250Hz)	–0.005 dB/kPa
Influence of humidity	>1000 years/dB at 20 C (68 F)
	<0.001 dB/100%RH
Vibration sensitivity (<1000 Hz)	65.5 dB equivalent SPL for 1 m/s ² axial acceleration
Magnetic field sensitivity	16 dB SPL for 80 A/m, 50 Hz field
Estimated long-term stability	>100 hours/dB at 150 C (302 F)

Physical

Dimensions

Diameter	13.2 mm (0.52 inches) (with grid)
	12.7 mm (0.50 inches) (without grid)
Height	13.5 mm (0.53 inches) (with grid)
	12.6 mm (0.50 inches) (without grid)
	27.6 mm (1.09 inches) (with UC 0211 and grid)
	26.7 mm (1.05 inches) (with UC 0211, no grid)
Thread for preamplifier mounting	11.7 mm – 60UNS

Microphone Model Gras 40AE

Open-circuit sensitivity (250Hz):

50 mV/Pa

IEC 1094-4 designation WS2F

Polarization voltage (external): 0V, prepolarized

Frequency response:

Pressure-field response:

5 Hz to 10 kHz –1dB

3.15 Hz to 20 kHz –2dB

Lower limiting frequency (–3 dB)

3.15 Hz

Pressure equalization vent

Side vented

Diaphragm resonance frequency

Unknown

Capacitance (polarized, 250Hz)

17 pF

Equivalent air volume (101.3 kPa)

Unknown

Calibrator load volume (250 Hz)

Unknown

Pistonphone 4228 correction (with DP 0776)

Unknown

Cartridge thermal noise

14.5 dB (A)

Upper limit of dynamic range (3% dist)

148 dB SPL

Maximum sound pressure level

148 dB (peak)

Environmental

Operating temperature range

–40 to +120 C

Operating humidity range

0 to 100% RH (without condensation)

Storage temperature

Unknown

Temperature coefficient (250 Hz)

–0.01 dB/ C

Pressure coefficient (250Hz)

–0.007 dB/kPa

Influence of humidity

<0.1 dB (0-100%RH)

Vibration sensitivity (<1000 Hz)

63 dB equivalent SPL for 1 m/s² axial
acceleration

Magnetic field sensitivity

Unknown

Estimated long-term stability

Unknown

Physical

Dimensions

Diameter 13.2 mm (with grid)

12.7 mm (without grid)

Height 16.2 mm (with grid)

15.3 mm (without grid)

Thread for preamplifier mounting

11.7 mm – 60UNS

Microphone Model Gras 40AQ

Open-circuit sensitivity (250Hz):

50 mV/Pa

IEC 1094-4 designation WS2F

Polarization voltage (external): 0V, prepolarized

Frequency response:

Pressure-field response:

12.5 Hz to 8 kHz –1dB

3.15 Hz to 12.5 kHz –2dB

Lower limiting frequency (–3 dB)

3.15 Hz

Pressure equalization vent

Rear vented

Diaphragm resonance frequency

14 kHz

Capacitance (polarized, 250Hz)

20 pF

Equivalent air volume (101.3 kPa)

50 mm³

Calibrator load volume (250 Hz)

Unknown

Pistonphone 4228 correction (with DP 0776)

Unknown

Cartridge thermal noise

16 dB (A)

Upper limit of dynamic range (3% dist)

148 dB SPL

Maximum sound pressure level

148 dB (peak)

Environmental

Operating temperature range

–40 to +120 C

Operating humidity range

0 to 100% RH (without condensation)

Storage temperature

Unknown

Temperature coefficient (250 Hz)

–0.01 dB/ C

Pressure coefficient (250Hz)

–0.008 dB/kPa

Influence of humidity

<0.1 dB (0-100%RH)

Vibration sensitivity (<1000 Hz)

65 dB equivalent SPL for 1 m/s² axial
acceleration

Magnetic field sensitivity

Unknown

Estimated long-term stability

Unknown

Physical

Dimensions

Diameter 13.2 mm (with grid)

12.7 mm (without grid)

Height 16.2 mm (with grid)

15.3 mm (without grid)

Thread for preamplifier mounting

11.7 mm – 60UNS

Microphone Model PCB 130D10**Performance**

Frequency Response Characteristic (at 0° incidence)

Frequency Response (± 1 dB)

Frequency Response (-2 to 5 dB)

Phase Match (100 Hz to 5 kHz)

Sensitivity (@ 1 kHz)

Sensitivity (± 3 dB) (@ 1 kHz)

Inherent Noise (1/3 Octave @ 1 kHz)

Inherent Noise (Linear Spec. 100 Hz to 10 kHz)

Dynamic Range (3% Distortion Limit)

Environmental

Temperature Range (Operating)

Temperature Effect on Output (-10 to +50 °C)

Physical

Dimensions

Diameter 5.5 mm

Height 25.9 mm

SI

Free-Field

100 to 4000 Hz

20 to 15000 Hz

 $\pm 5^\circ$ [1]

45 mV/Pa

-26.9 dB re 1 V/Pa

<15 dB

<30 dB

>122 dB

-10 to +50 °C

<0.7 dB

Microphone Model PCB 130D21**Performance**

Frequency Response Characteristic (at 0° incidence)

Frequency Response (± 1 dB)

Frequency Response (-2 to 5 dB)

Phase Match (100 Hz to 5 kHz)

Sensitivity (@ 1 kHz)

Sensitivity (± 3 dB) (@ 1 kHz)

Inherent Noise (1/3 Octave @ 1 kHz)

Inherent Noise (Linear Spec. 100 Hz to 10 kHz)

Dynamic Range (3% Distortion Limit)

Environmental

Temperature Range (Operating)

Temperature Effect on Output (-10 to +50 °C)

Physical

Dimensions

Diameter 5.5 mm

Height 25.9 mm

SI

Free-Field

100 to 4000 Hz

20 to 15000 Hz

 $\pm 5^\circ$ [1]

45 mV/Pa

-26.9 dB re 1 V/Pa

<15 dB

<30 dB

>122 dB

-10 to +50 °C

<0.7 dB

National Instruments 4472B Data Acquisition Boards

Channel Characteristics

Number of channels	8, simultaneously sampled
Input configuration	Unbalanced differential
Resolution	24 bits, nominal
Type of ADC	Delta-sigma
Oversampling, for sample rate (f_s)	
$1.0 \text{ kS/s} \leq f_s \leq 51.2 \text{ kS/s}$	128 times f_s
$51.2 \text{ kS/s} < f_s \leq 102.4 \text{ kS/s}$	64 times f_s
Sample rates (f_s)	1.0 to 102.4 kS/s
190.7 $\mu\text{S/s}$ increments for $f_s > 51.2 \text{ kS/s}$	
95.36 $\mu\text{S/s}$ increments for $f_s \leq 51.2 \text{ kS/s}$	
Frequency accuracy	$\pm 25 \text{ ppm}$
Input signal range	$\pm 10 \text{ V}$ peak
FIFO buffer size	1,024 samples
Data transfers	DMA

Transfer Characteristics

Offset (residual DC)	$\pm 3 \text{ mV}$, max
Gain (amplitude accuracy)	$\pm 0.1 \text{ dB}$, max, $f_{in} = 1 \text{ kHz}$

Amplifier Characteristics

Input impedance (ground referenced)	
Positive input	1 M Ω in parallel with 60 pF
Negative input (shield)	50 Ω in parallel with 0.02 μF
Flatness (relative to 1 kHz)	$\pm 0.1 \text{ dB}$, DC to 0.4535 f_s , max, DC-coupled
-3 dB bandwidth	0.4863 f_s
Input coupling	AC or DC, software-selectable
AC Coupling -3 dB cutoff frequency	0.5 Hz
Overvoltage protection	
Positive input	$\pm 42.4 \text{ V}$
Positive inputs protected	CH<0..7>
Negative input (shield)	Not protected, rated at $\pm 2.5 \text{ V}$
Common mode rejection ratio (CMRR)	
$f_{in} < 1 \text{ kHz}$	$> 60 \text{ dB}$, minimum

National Instruments 4472B Data Acquisition Boards (Concluded)

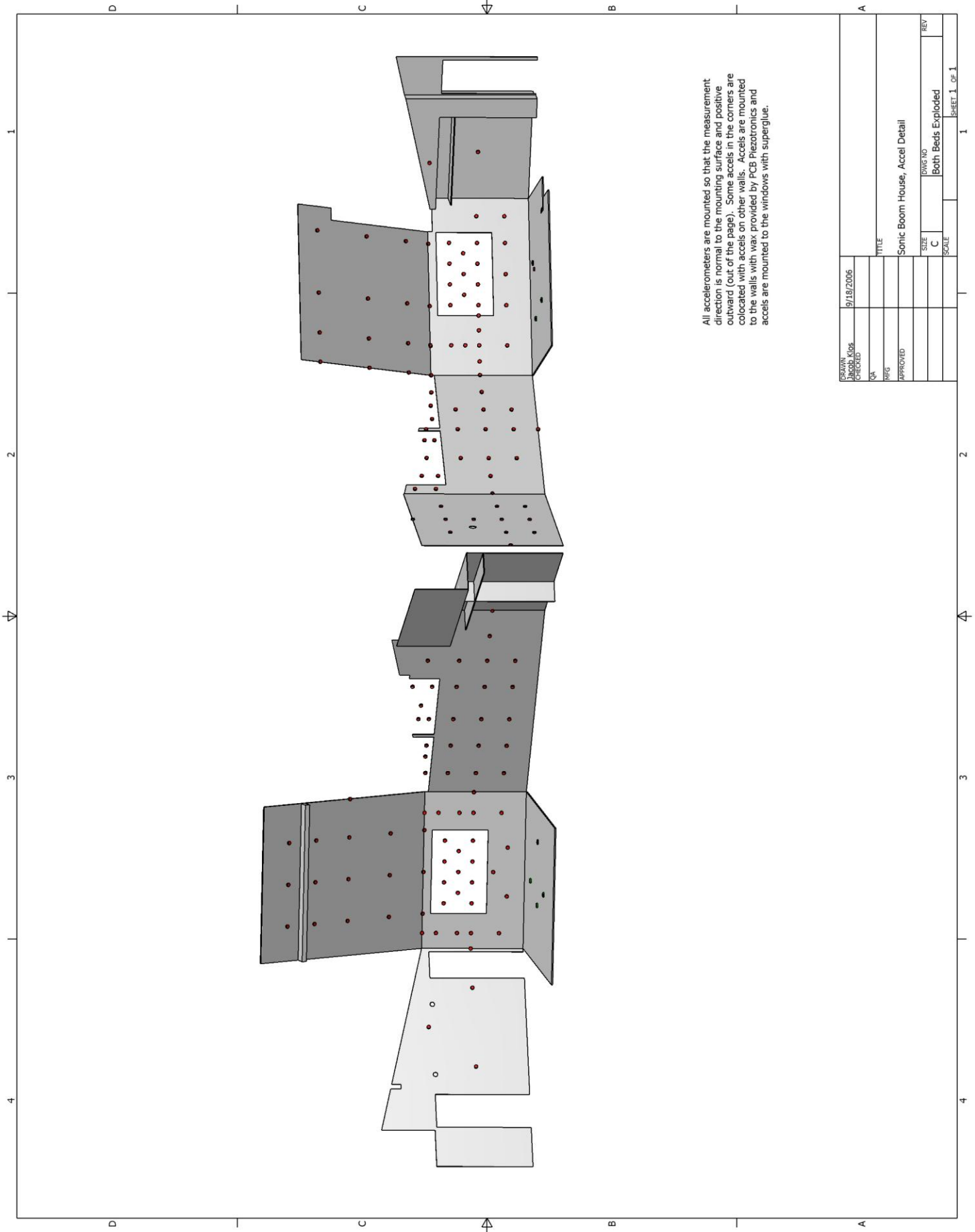
Dynamic Characteristics

Alias-free bandwidth (passband)	DC (0 Hz) to $0.4535 f_s$
Stop band	$0.5465 f_s$
Alias rejection	110 dB
Spurious-free dynamic range	130 dB, $1.0 \text{ kS/s} \leq f_s \leq 51.2 \text{ kS/s}$, 118 dB, $51.2 \text{ kS/s} < f_s \leq 102.4 \text{ kS/s}$ THD For $f_{in} = 1 \text{ kHz}$
Crosstalk1 (channel separation) for $f_{in} = 0$ to 51.2 kHz	
Between channels 0 and 1, 2 and 3, 4 and 5, or 6 and 7	
Shorted input	<-90 dB
1 k $\frac{1}{2}$ load	<-80 dB
Other channel combinations	
Shorted input	<-100 dB
1 k $\frac{1}{2}$ load	<-90 dB
Phase linearity	$<\pm 0.5 \text{ deg}$
Interchannel phase mismatch	$<f_{in} \text{ (in kHz)} \times 0.018 \text{ deg} + 0.082 \text{ deg}$
Interchannel gain mismatch	$\pm 0.1 \text{ dB}$
Filter delay through ADC	38.8 sample periods

Appendix E

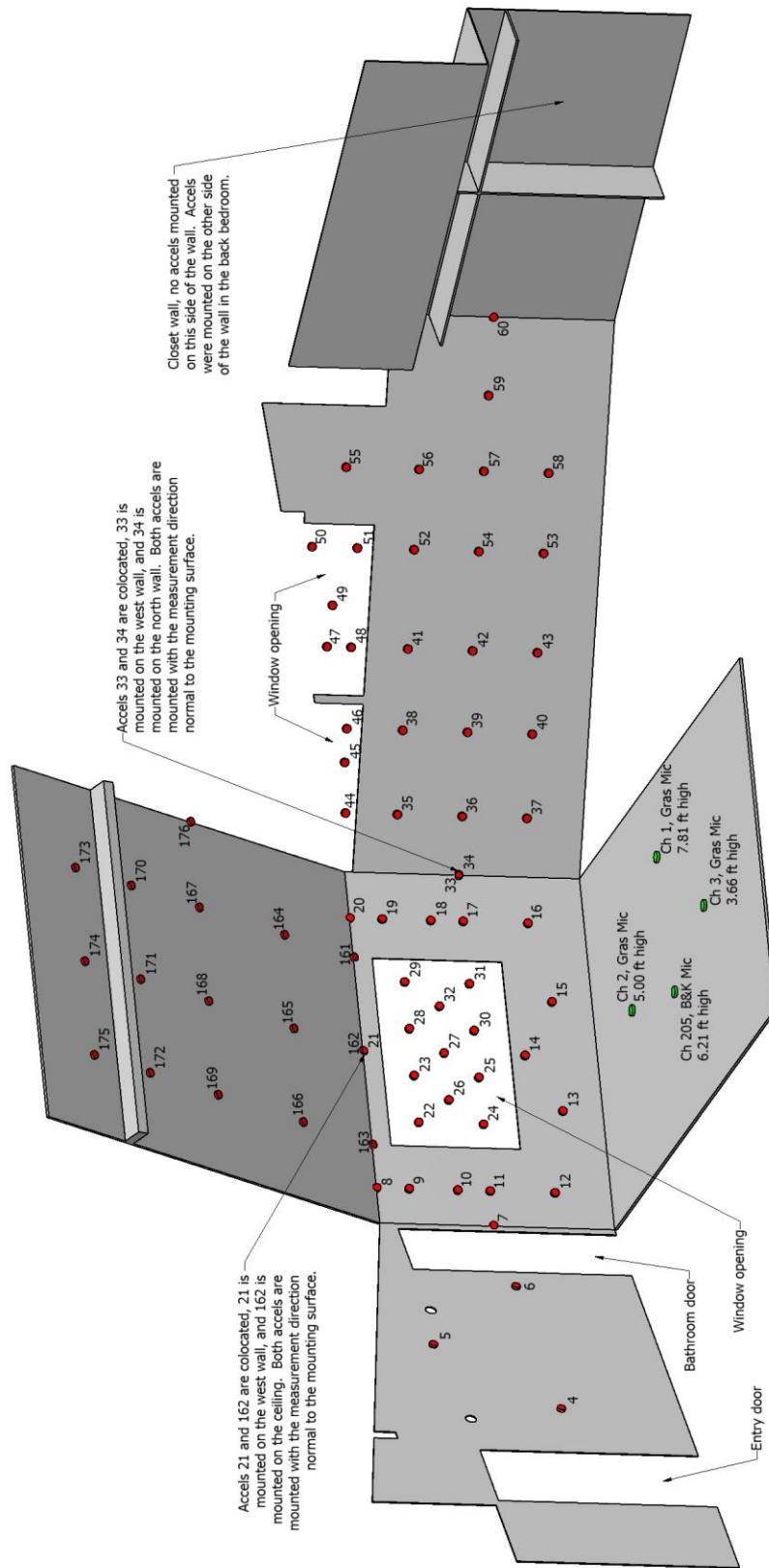
Drawings and pictures of the nominal interior accelerometers and microphone locations.

(All dimensions are in inches unless otherwise noted)

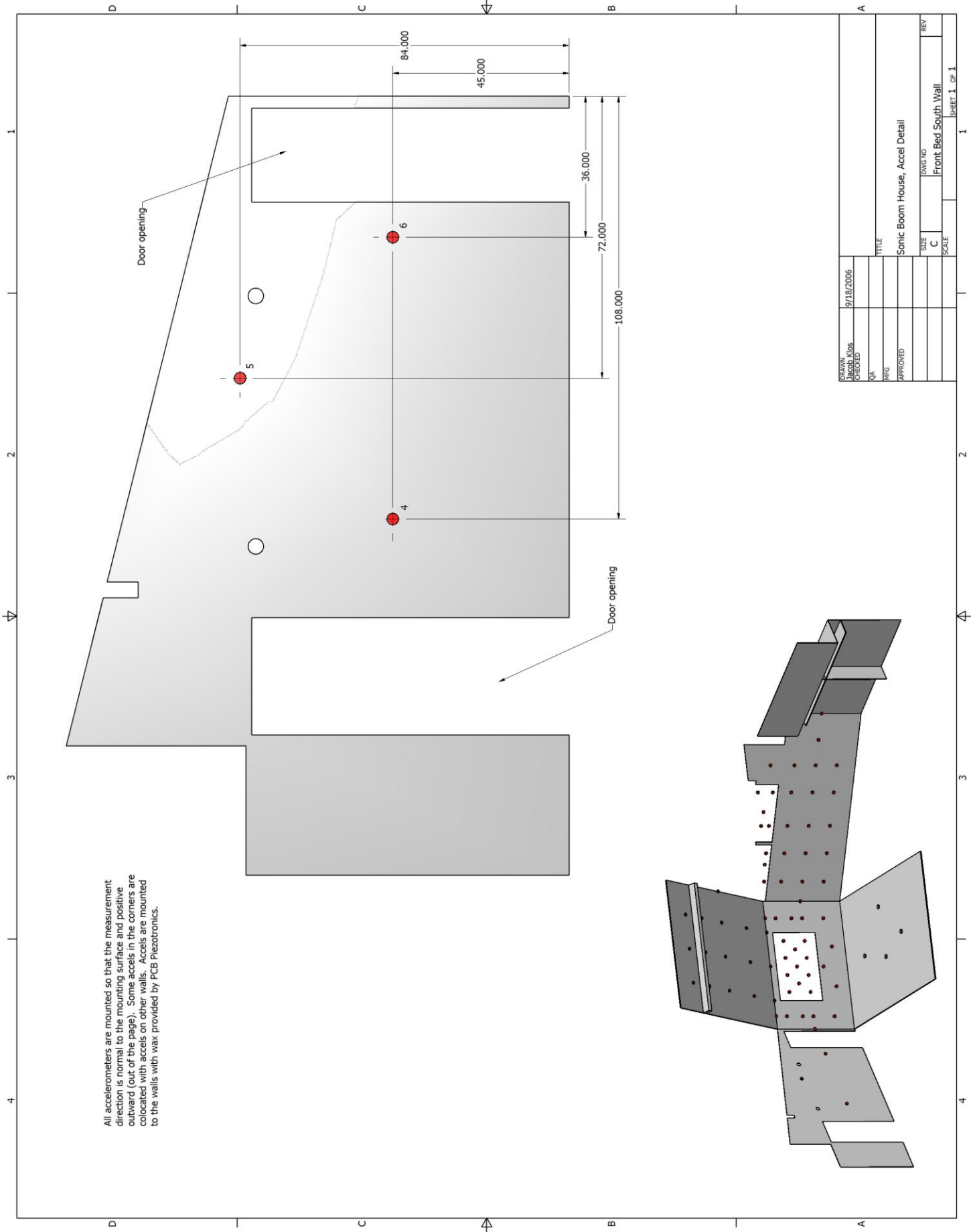


All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.

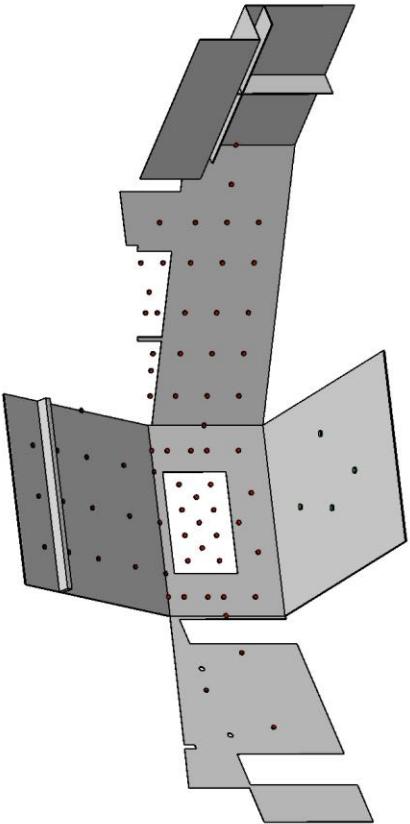
DRAWN	9/18/2006				
CHECKED					
QA					
PMG					
APPROVED					
TITLE					
Sonic Boom House, Accel Detail					
SIZE					
C					
SCALE					
Both Beds Exploded					
SHEET 1 OF 1					



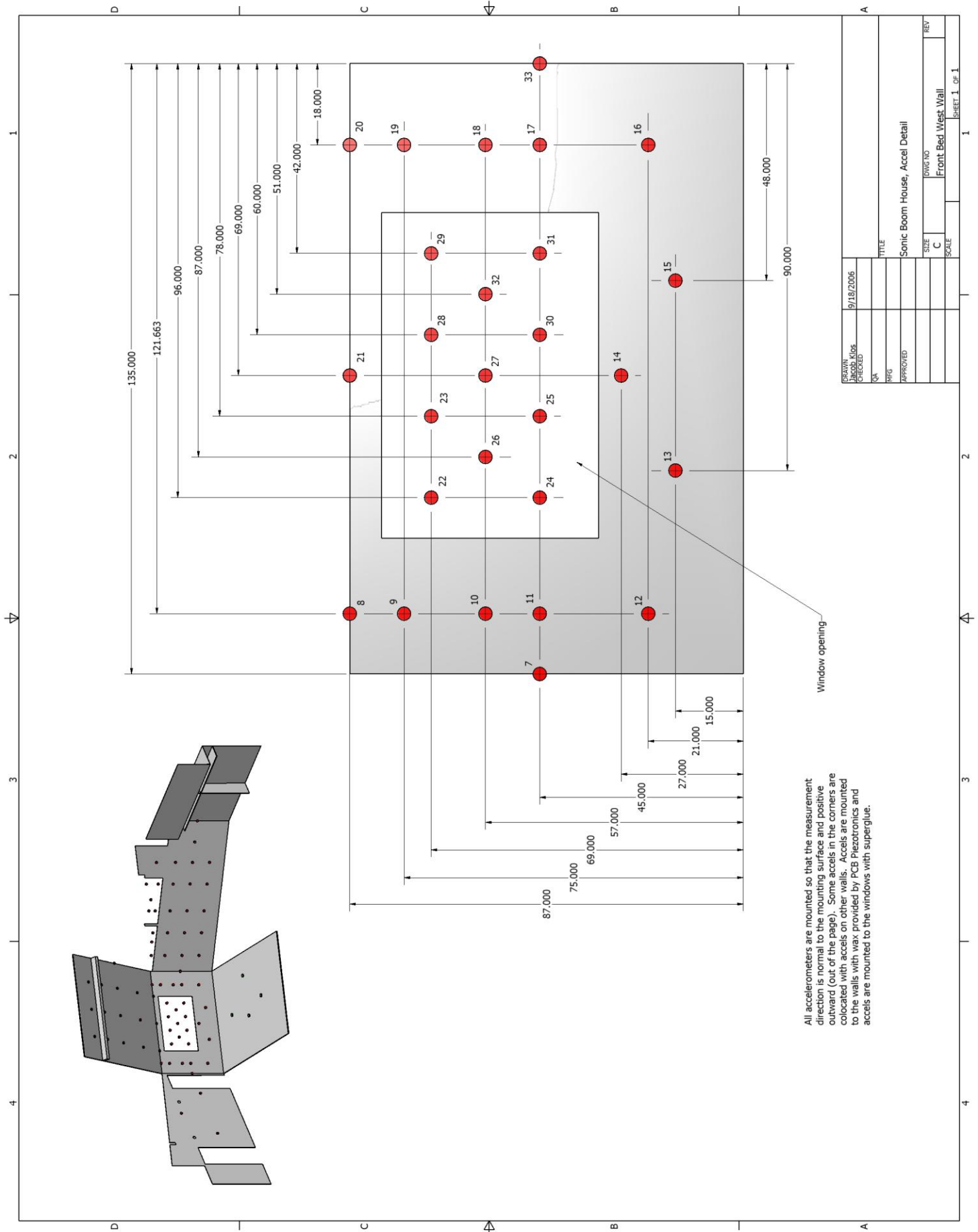
All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accelerals in the corners are collocated with accelerals on other walls. Accelerals are mounted to the walls with wax provided by PCB Piezotronics and accelerals are mounted to the windows with superglue.

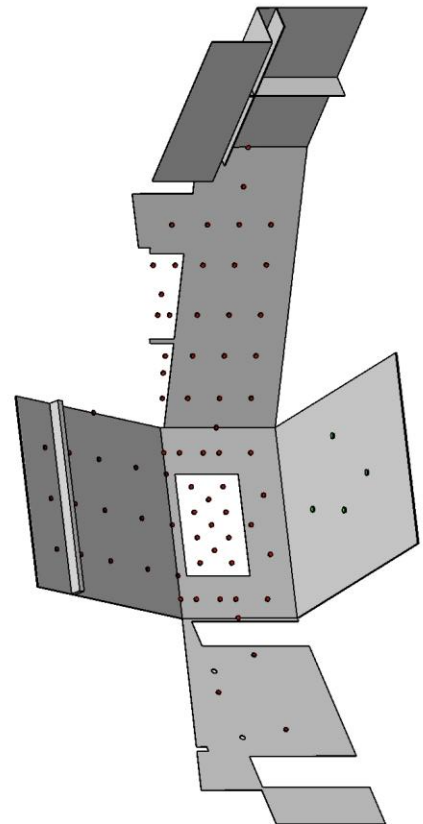
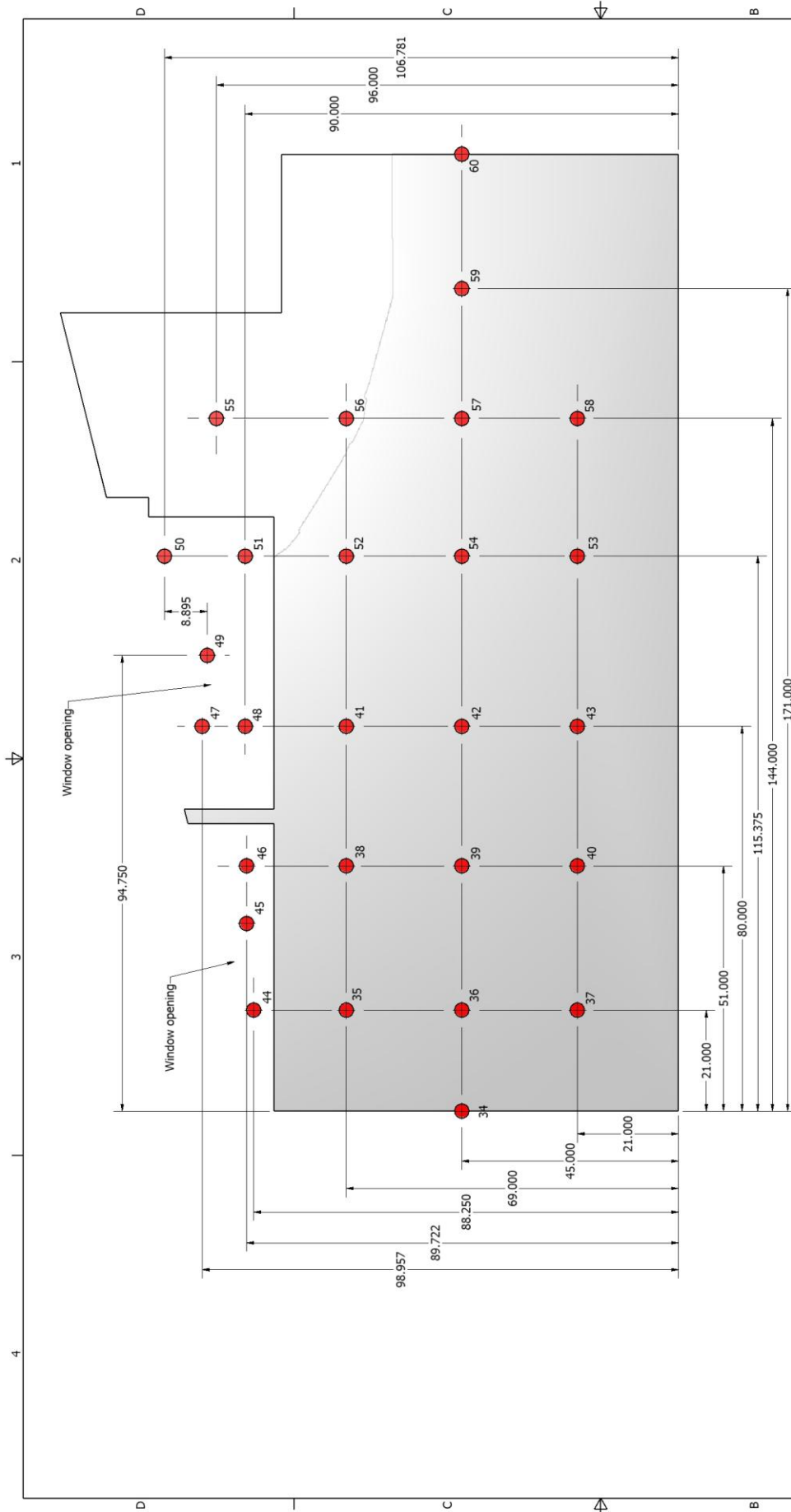


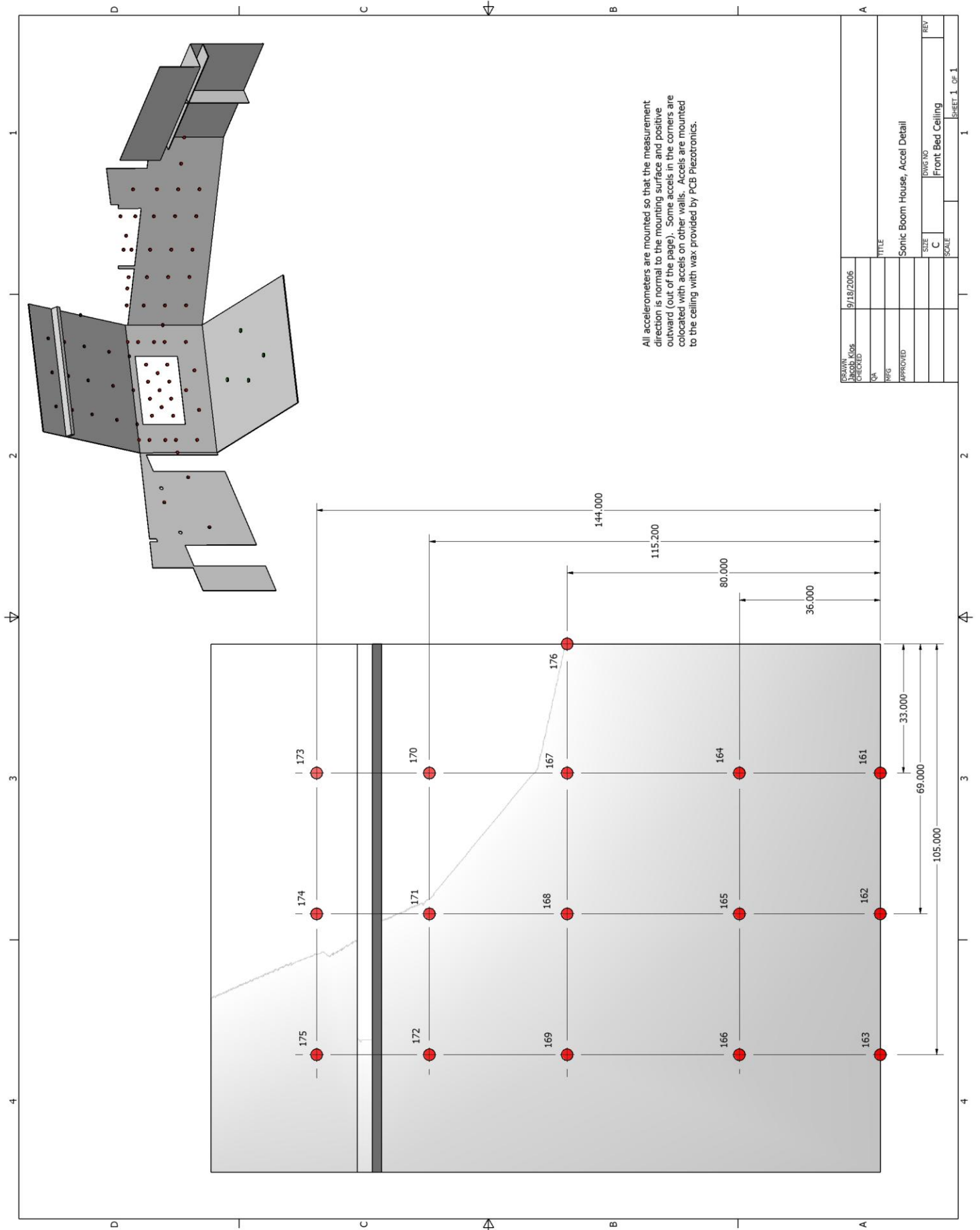
All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics.

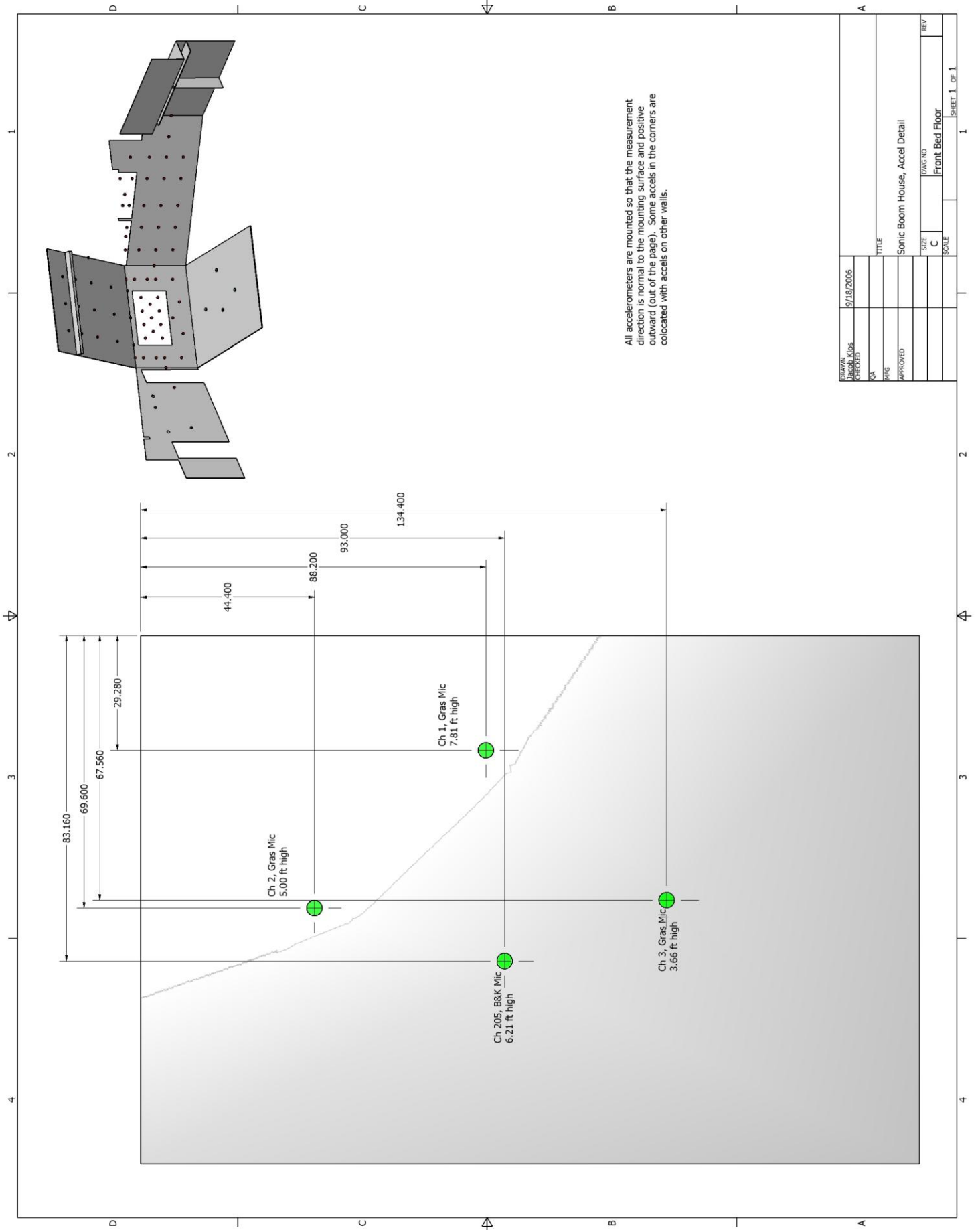


DRAWN	9/18/2006	TITLE	
CHECKED		DATE	
QA		REV	
APPROVED		SCALE	
Sonic Boom House, Accel Detail			
Front Bed South Wall			
SHEET 1 OF 1			



[illegible]



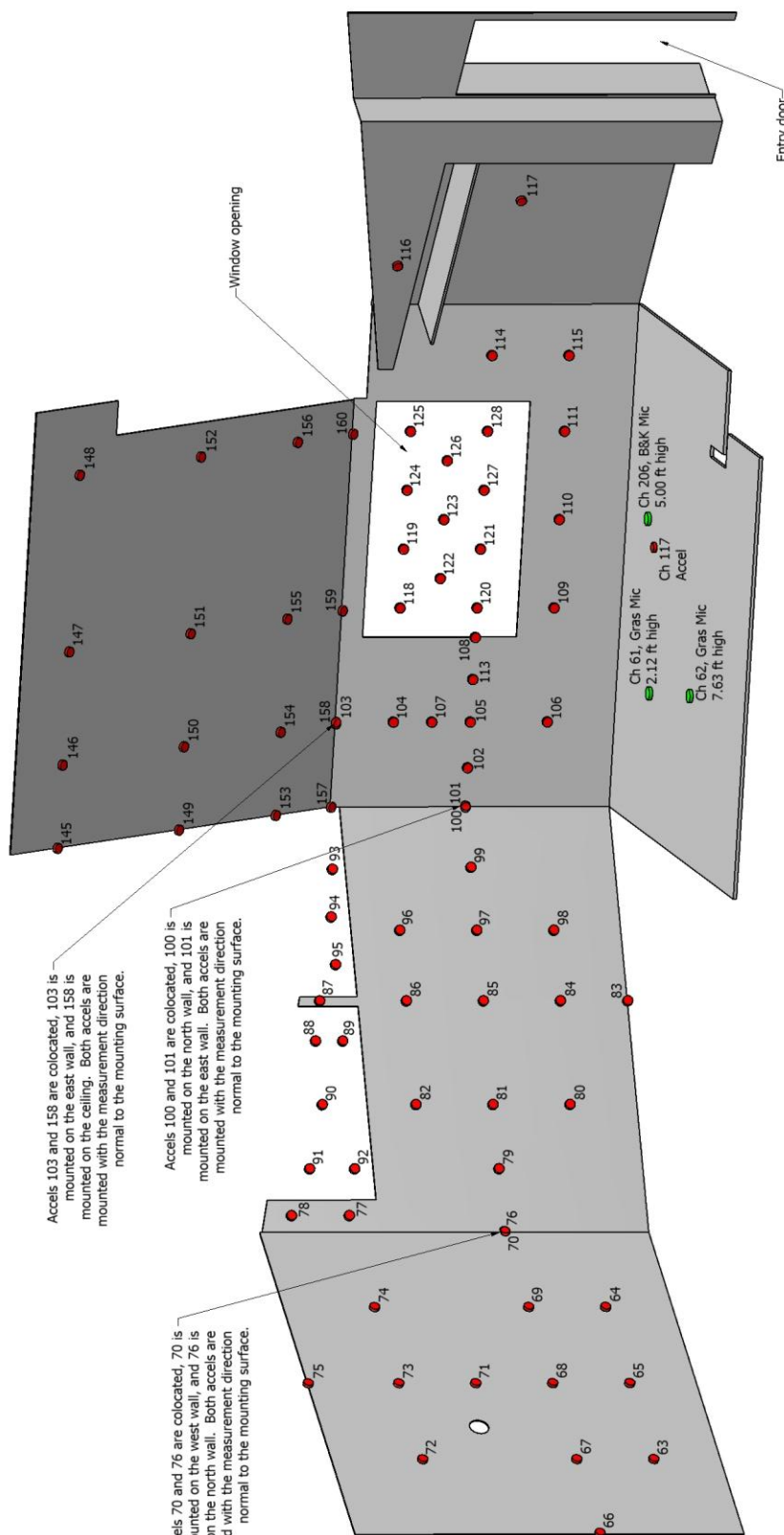


All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.

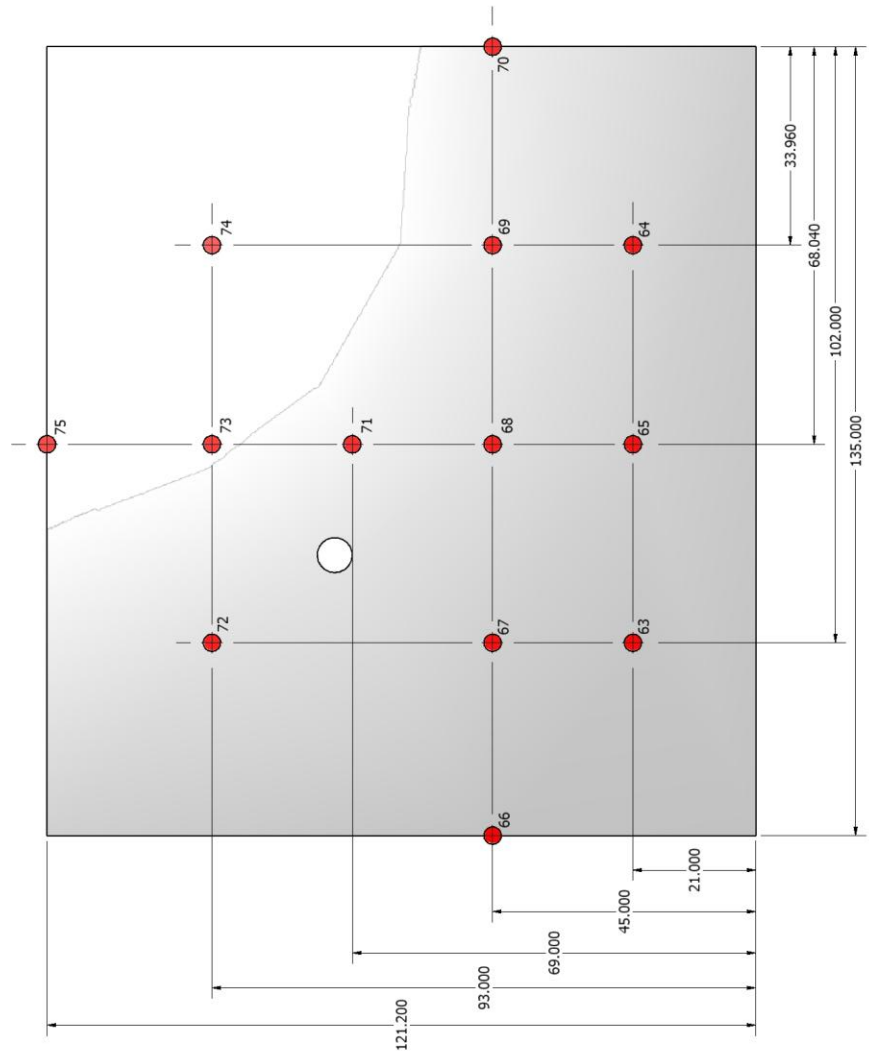
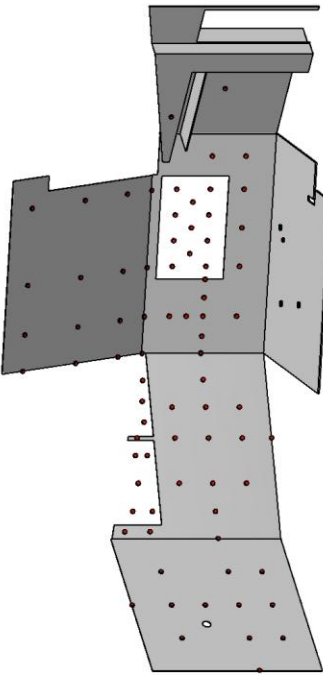
Accels 103 and 158 are collocated, 103 is mounted on the east wall, and 158 is mounted on the ceiling. Both accels are mounted with the measurement direction normal to the mounting surface.

Accels 100 and 101 are collocated, 100 is mounted on the north wall, and 101 is mounted on the east wall. Both accels are mounted with the measurement direction normal to the mounting surface.

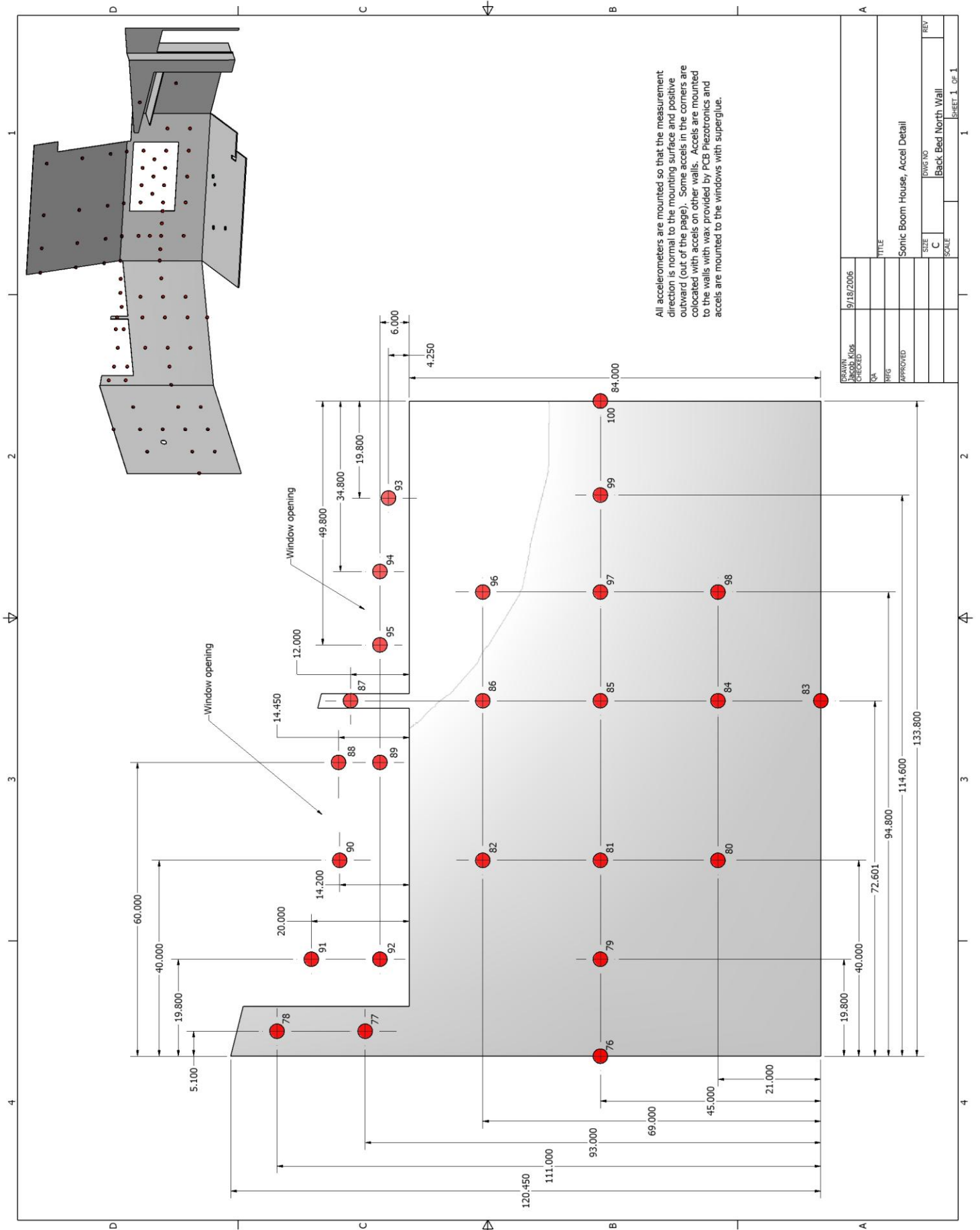
Accels 70 and 76 are collocated, 70 is mounted on the west wall, and 76 is mounted on the north wall. Both accels are mounted with the measurement direction normal to the mounting surface.



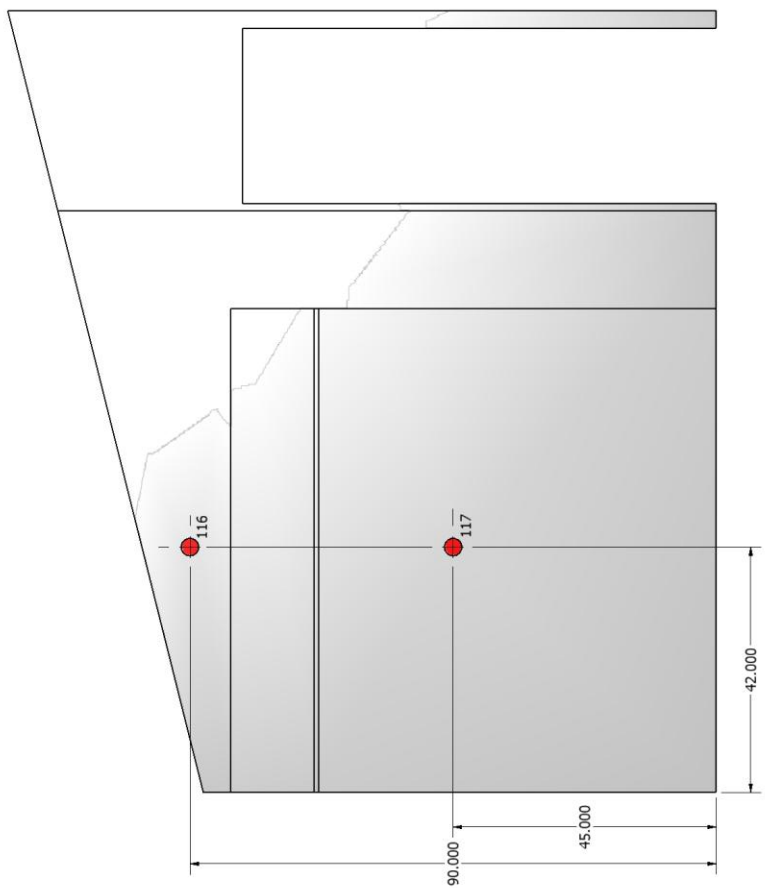
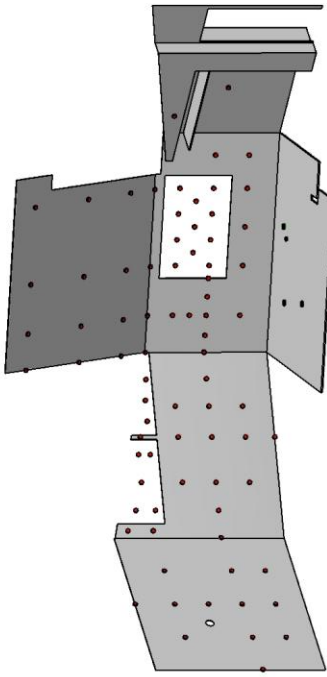
DRAWN	9/18/2006	TITLE	
CHECKED		QA	
INFG		APPROVED	
SIZE	C	DWG NO	
SCALE		Back Bed Exploded	
		REV	



DRAWN Jacob Klos CHECKED	9/18/2006				
OK		TITLE			
RFG		Sonic Boom House, Accel Detail			
APPROVED					
	SIZE	DWG NO	REV		
	C		Back Bed West Wall		
	SCALE				
		SHEET 1 OF 1			

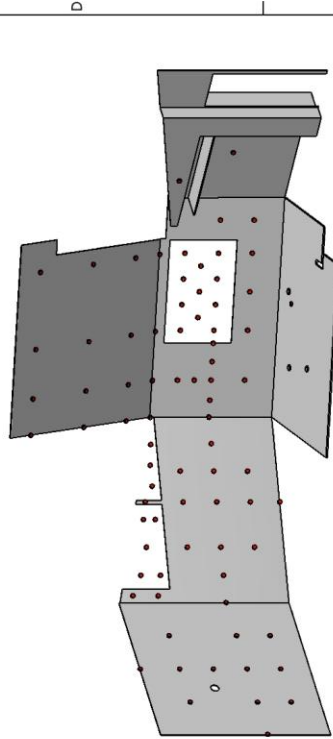
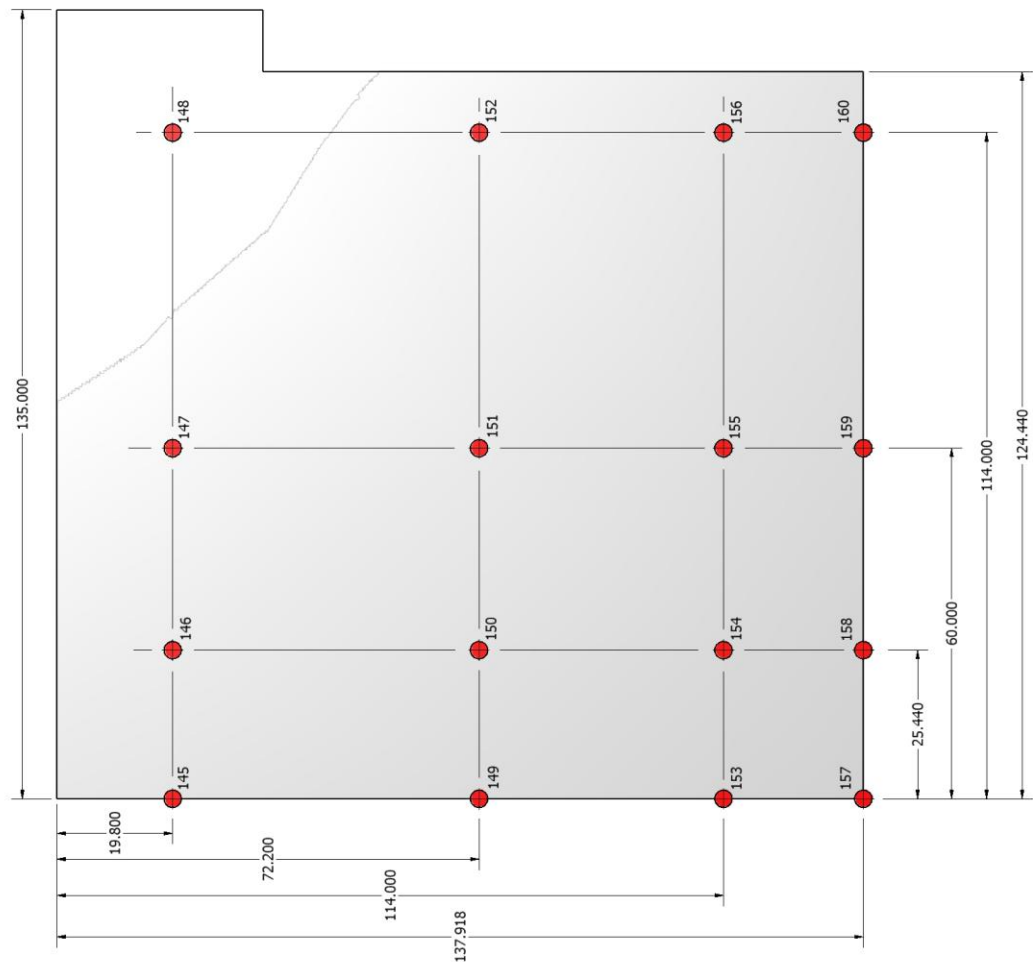


All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.



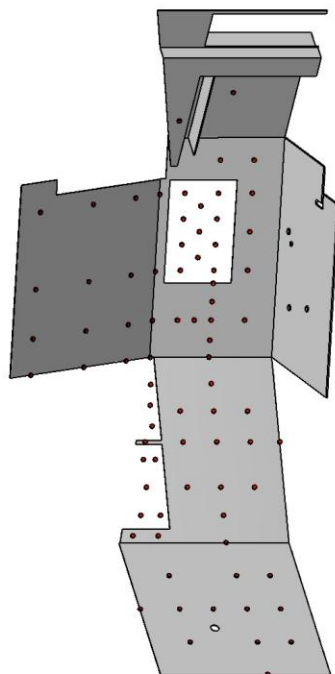
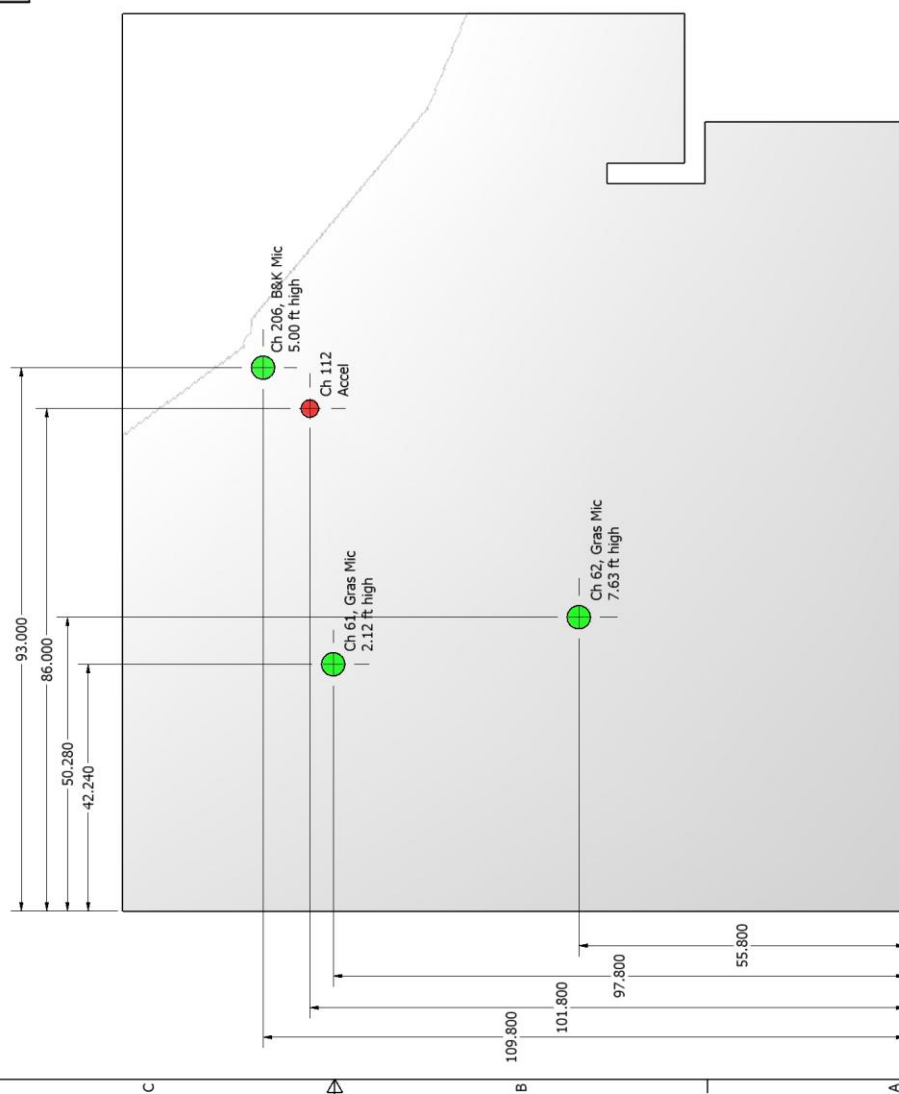
DRAWN	9/18/2006	A	
CHECKED			
QA			
PMG		TITLE	
APPROVED		Sonic Boom House, Accel Detail	
		SIZE	DWG NO
		C	Back Bed South Wall
		SCALE	REV
			1
			SHEET 1 OF 1

All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the ceiling with wax provided by PCB Piezotronics.

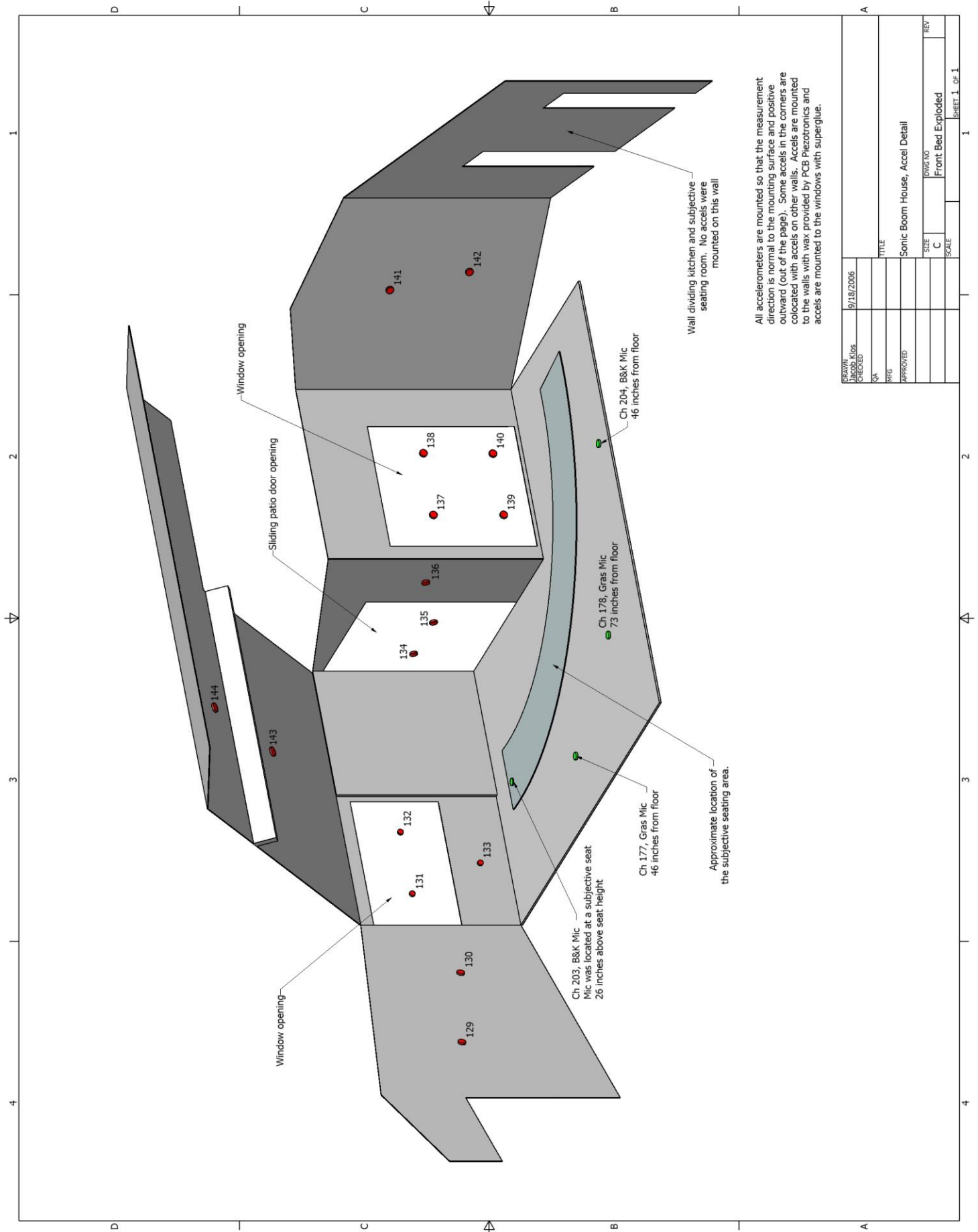


DRAWN	9/18/2006	TITLE	Sonic Boom House, Accel Detail
CHECKED		DATE	
QA		SCALE	
PMG		SIZE	C
APPROVED		DATE	
		REV	
		Back Bed Ceiling	
		SHEET 1 OF 1	

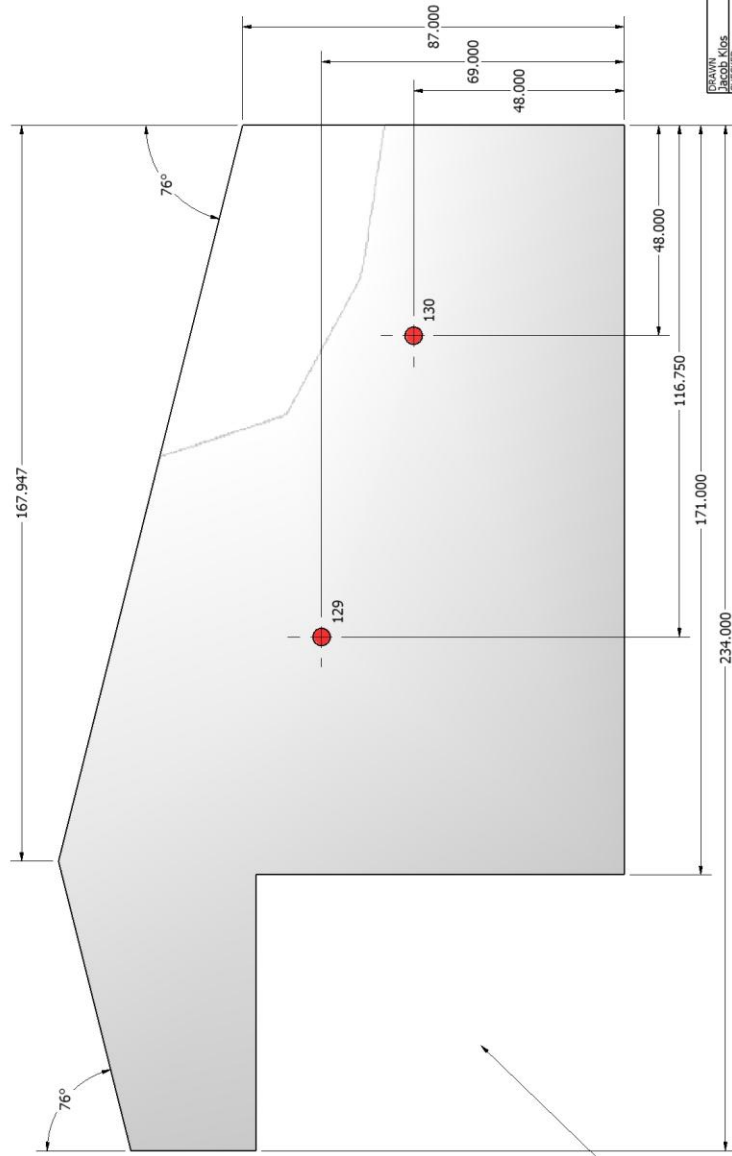
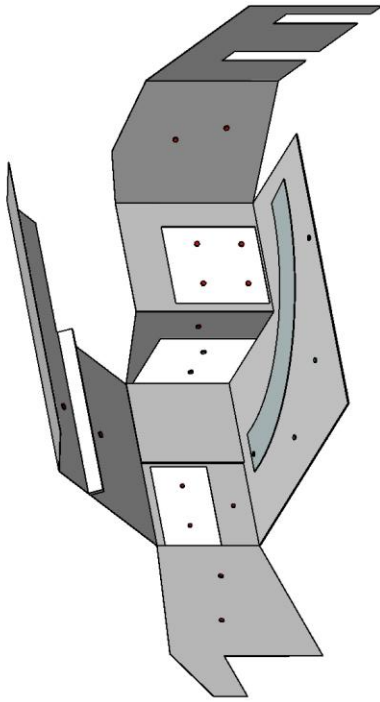
All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. The accel on channel 117 was moved part way through the test.



DRAWN	9/18/2006	TITLE	
CHECKED		DATE	
QA		SIZE	
PMG		SCALE	
APPROVED		DATE	
		REV	
		NO	
		Back Bed Floor	
		SHEET 1 OF 1	

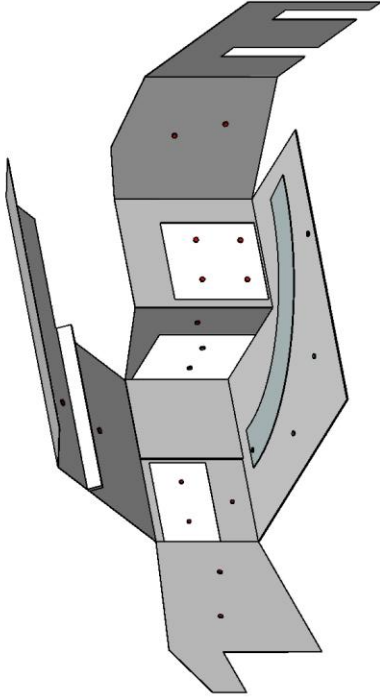
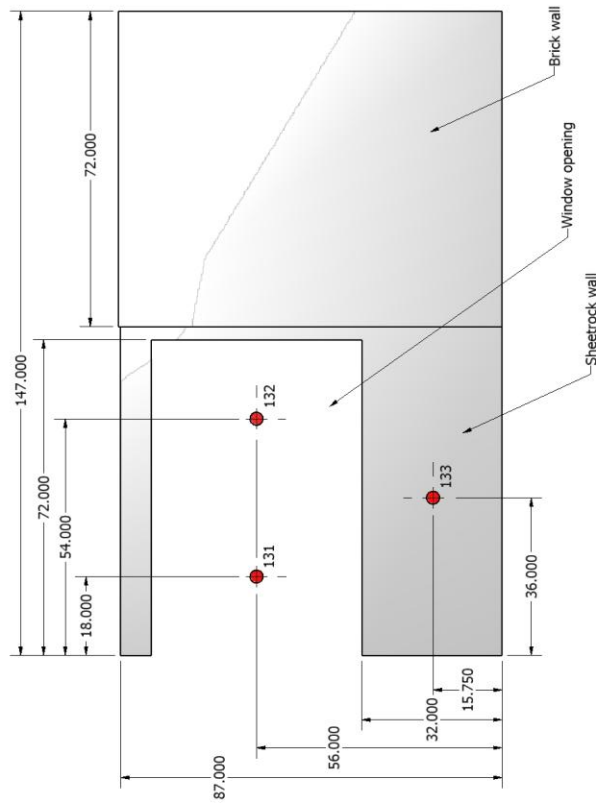


All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.



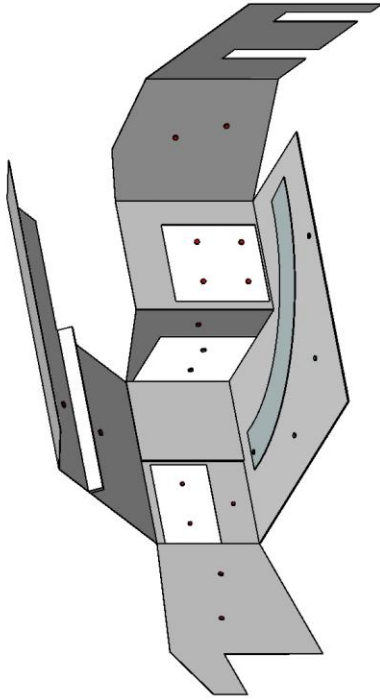
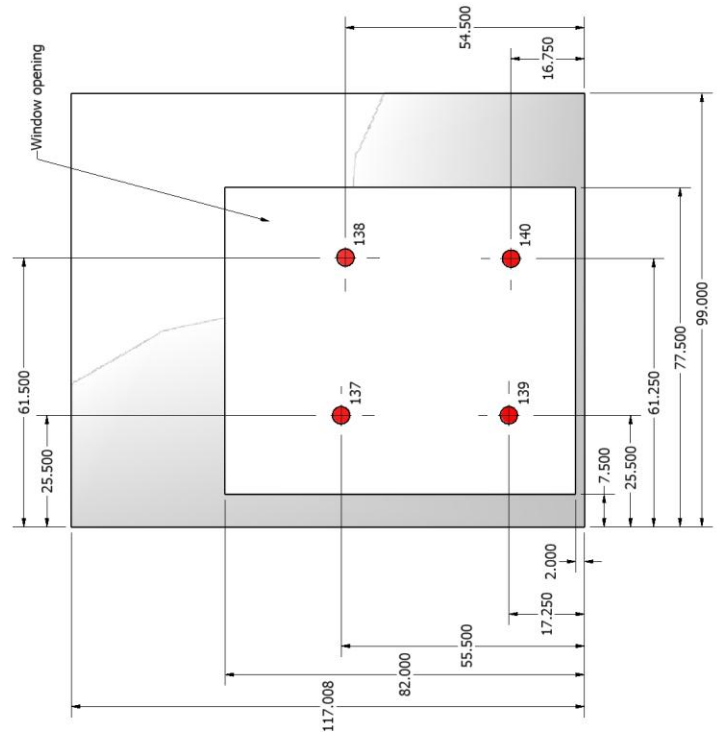
DRAWN	9/18/2006	TITLE	Sonic Boom House, Accel Detail
CHECKED		DATE	
QA		SIZE	C
APPROVED		SCALE	1 OF 1
		PROJECT NO	Subjective Room Floor
		REV	

All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.



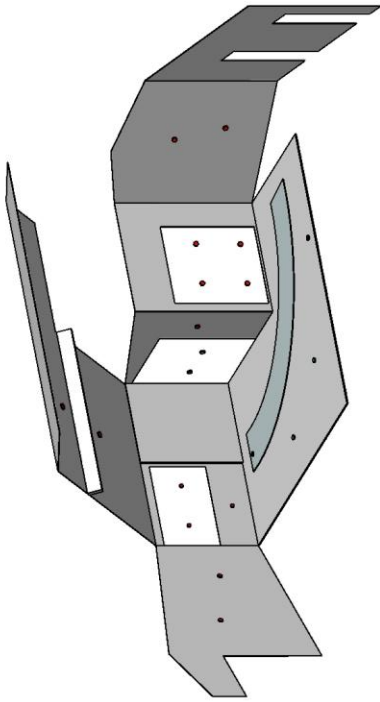
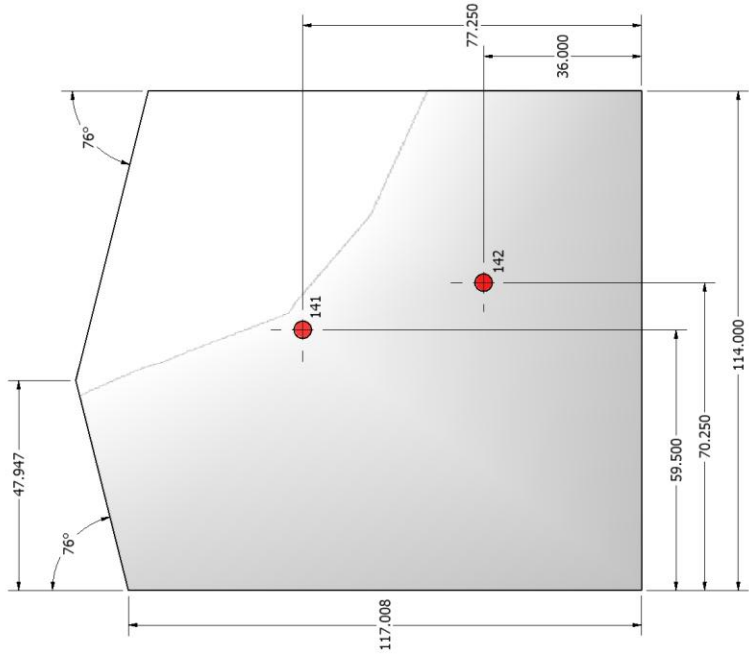
DRAWN	9/18/2006	TITLE	
CHECKED		QA	
QA		APPROVED	
DATE		SIZE	
NO.		C	
SCALE		1	
SHEET 1 OF 1			
Sonic Boom House, Accel Detail			
Subjective Room Floor			
REV			

All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.



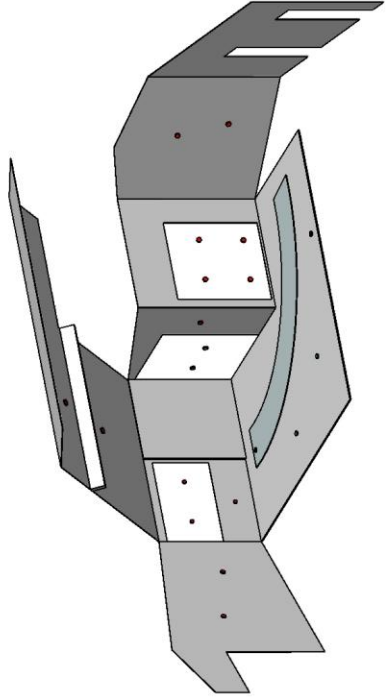
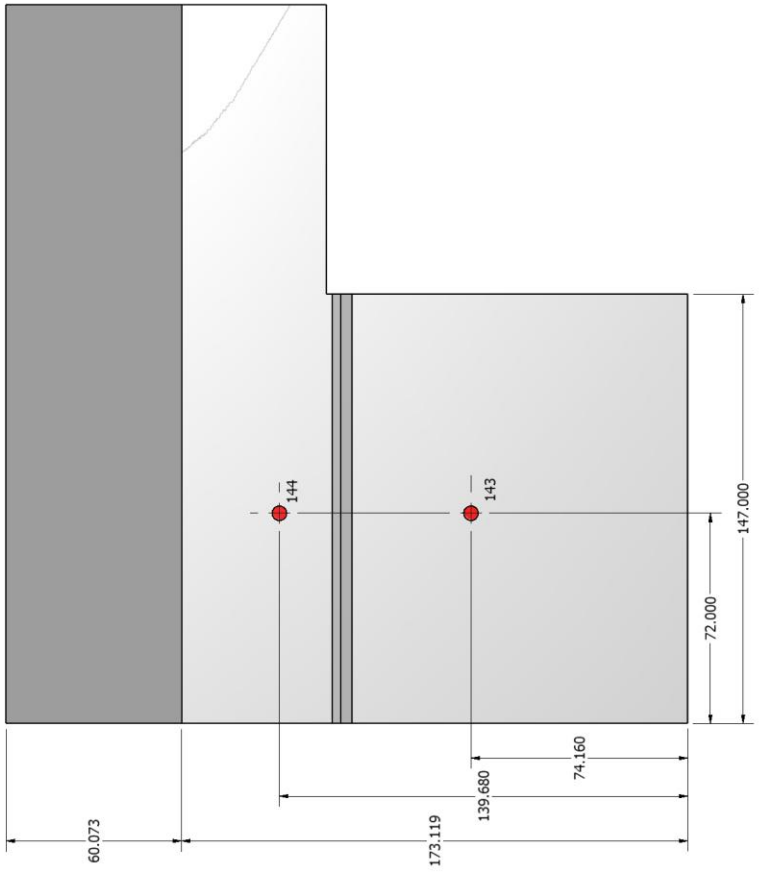
DRAWN	9/18/2006				
CHECKED					
QA					
APPROVED					
TITLE					
Sonic Boom House, Accel Detail					
SIZE					
C					
SCALE					
SHEET 1 OF 1					

All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.

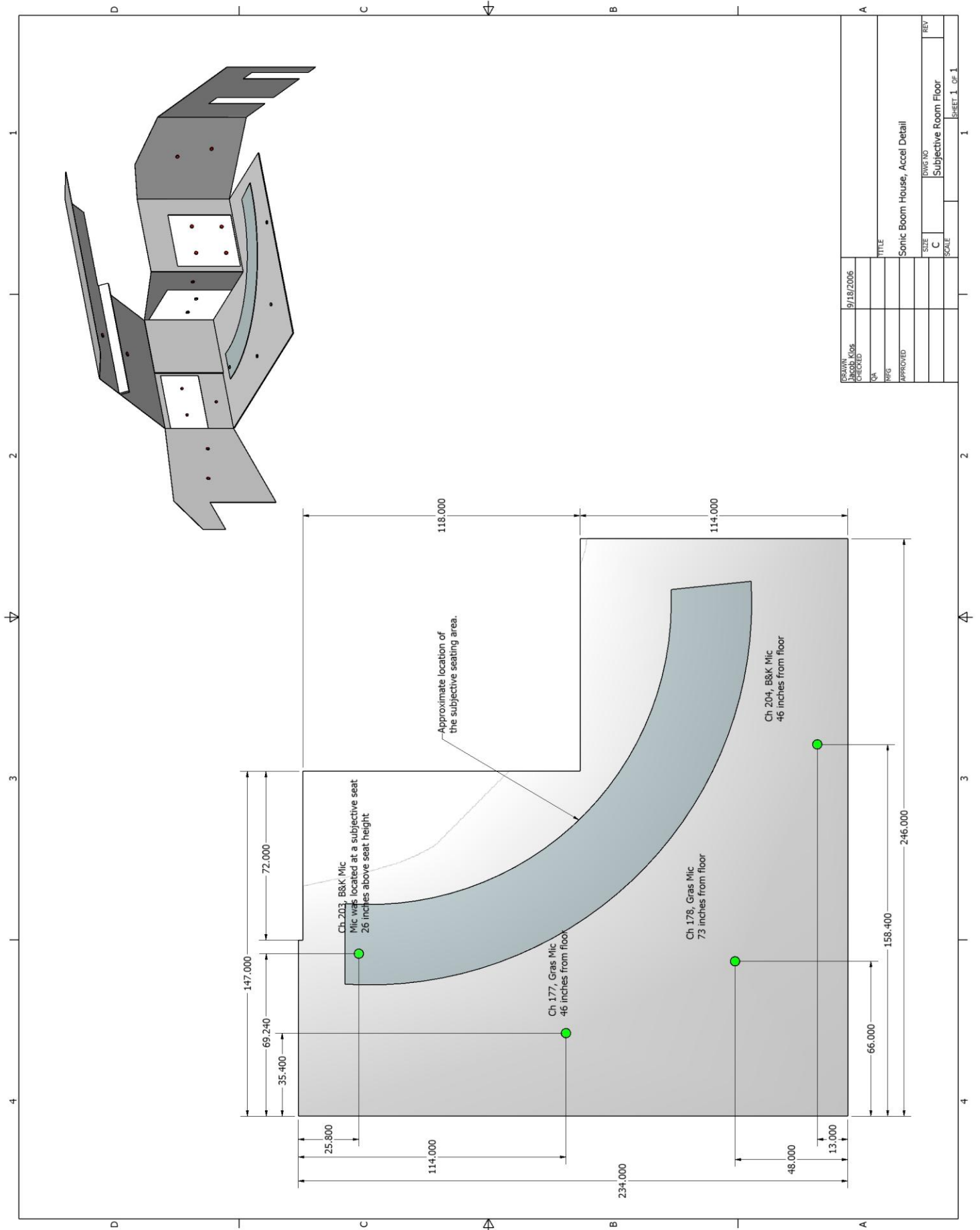


DRAWN	9/18/2006	A	
CHECKED			
QA		TITLE	
PMG		Sonic Boom House, Accel Detail	
APPROVED			
		SIZE	REV
		C	
		SCALE	Subjective Room Floor
		SHEET 1 OF 1	

All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.



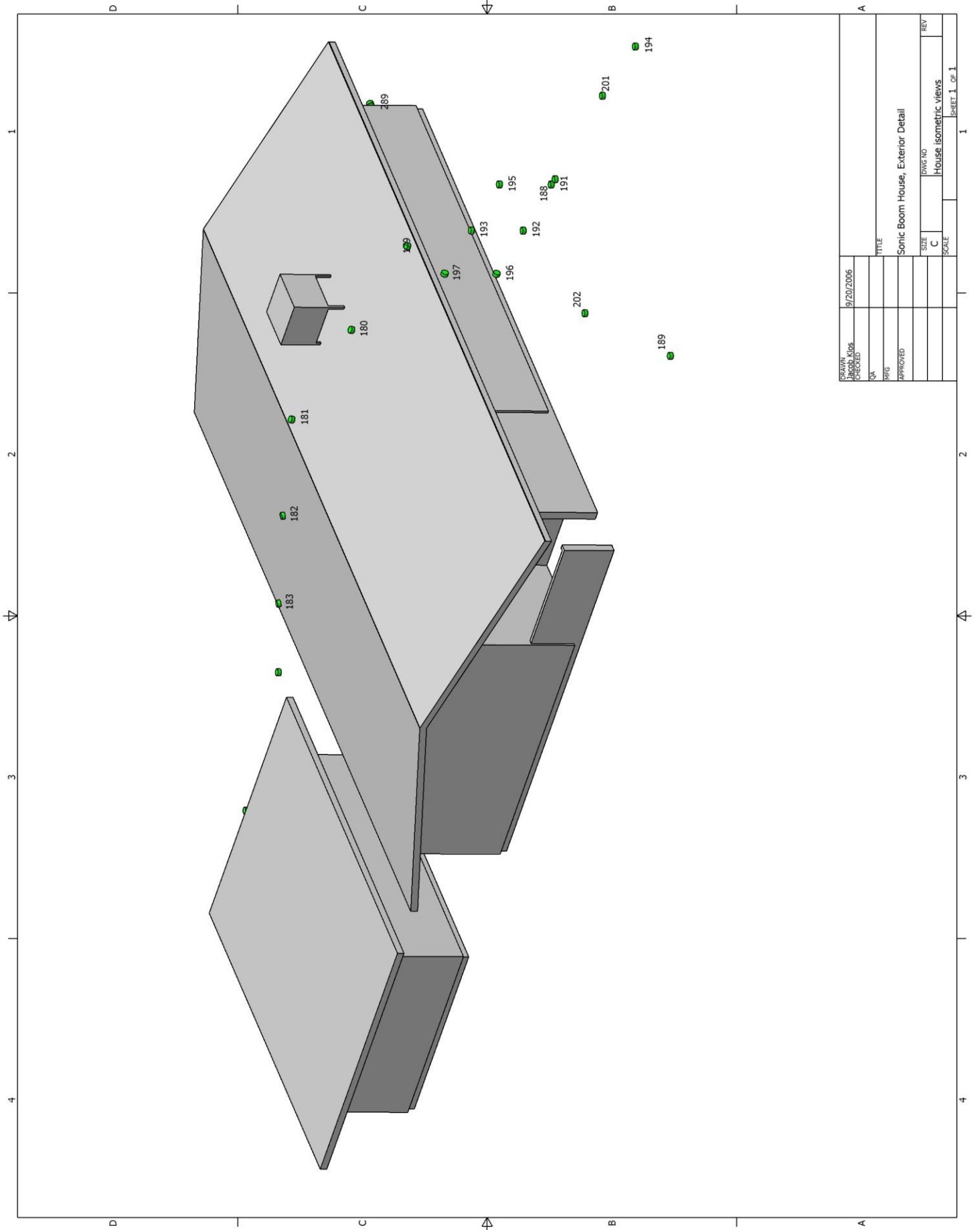
DRAWN	9/19/2006			
Jacob Kops				
CHECKED				
QA		TITLE		
MFG				
APPROVED		Sonic Boom House, Accel Detail		
		SIZE	DWG NO	REV
		C		
		SCALE	Subjective Room Floor	
				SHEET 1 OF 1



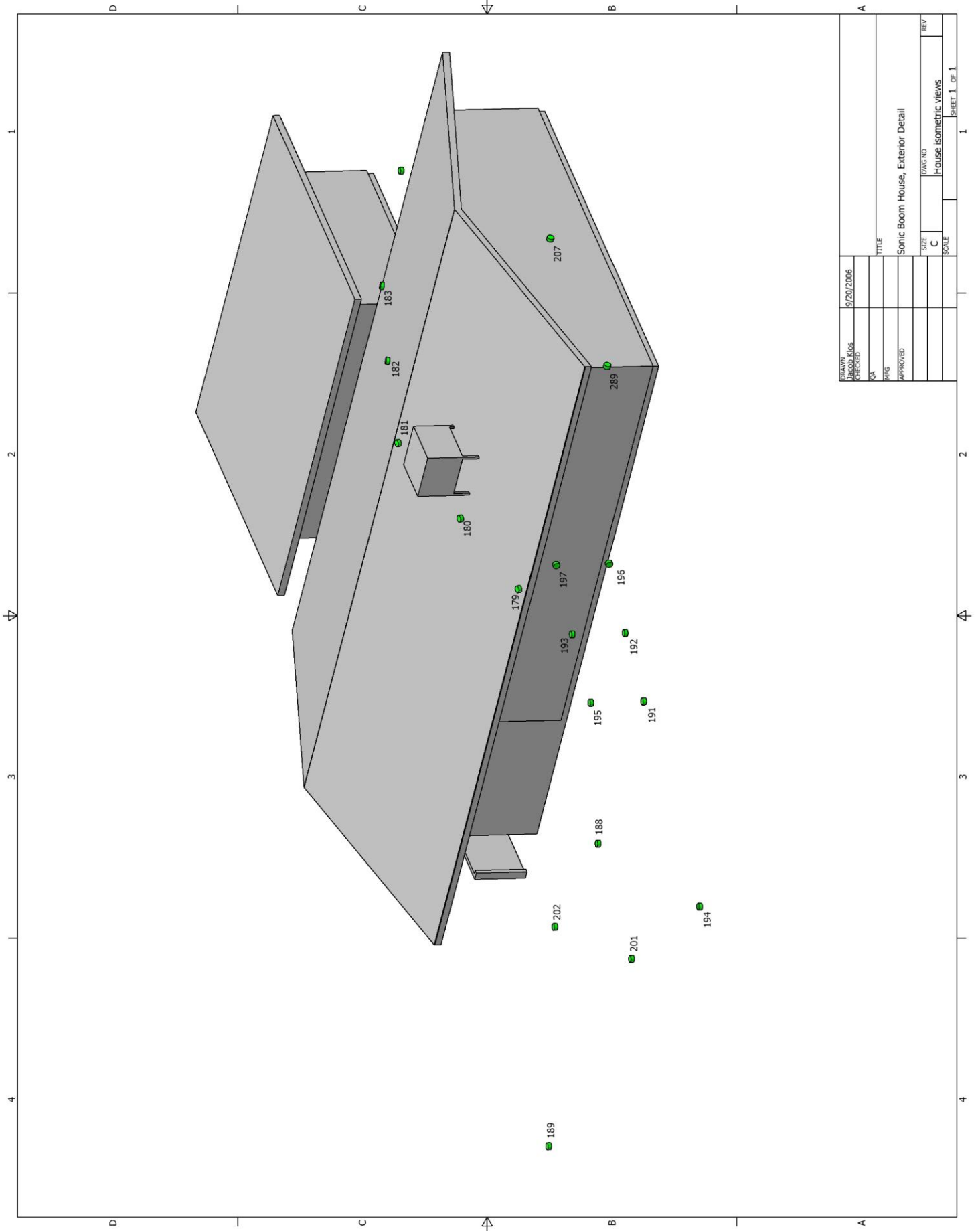
Appendix F

Drawings of the exterior microphone locations on June 13th through the 21st.

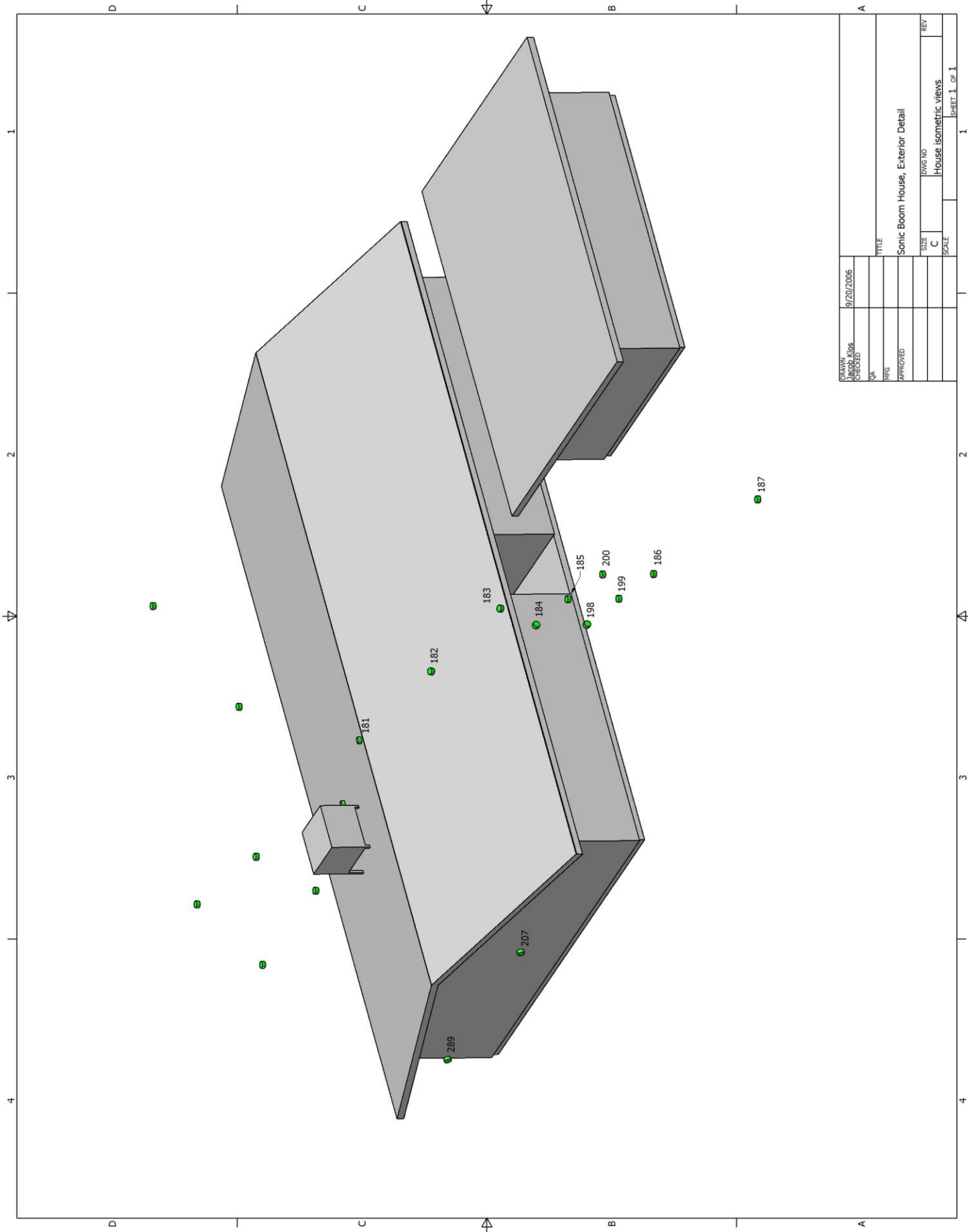
(All dimensions are in inches unless otherwise noted)



DRAWN	9/20/2006	A	
CHECKED			
QA		TITLE	
PMG		Sonic Boom House, Exterior Detail	
APPROVED			
		SIZE	REV
		C	
		SCALE	House Isometric views
		SHEET 1 OF 1	



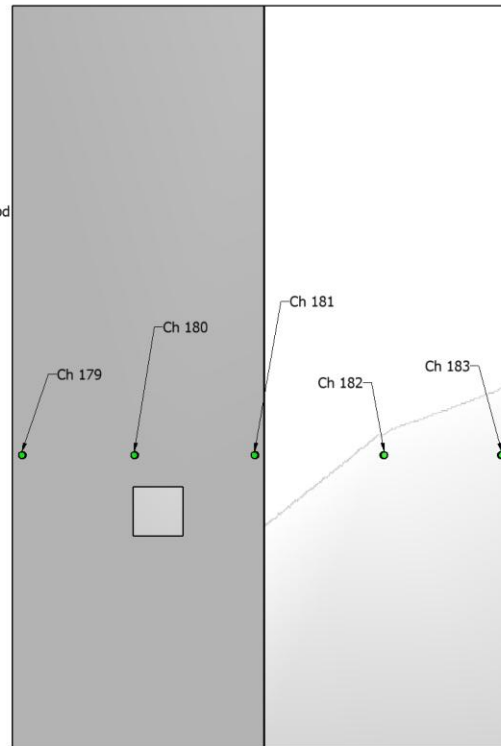
DRAWN CHECKED QA MFG APPROVED	9/20/2006	TITLE			
		Sonic Boom House, Exterior Detail			
		SIZE	DWG NO	REV	
		C	House Isometric views		
		SCALE		1	
				SHEET 1 OF 1	



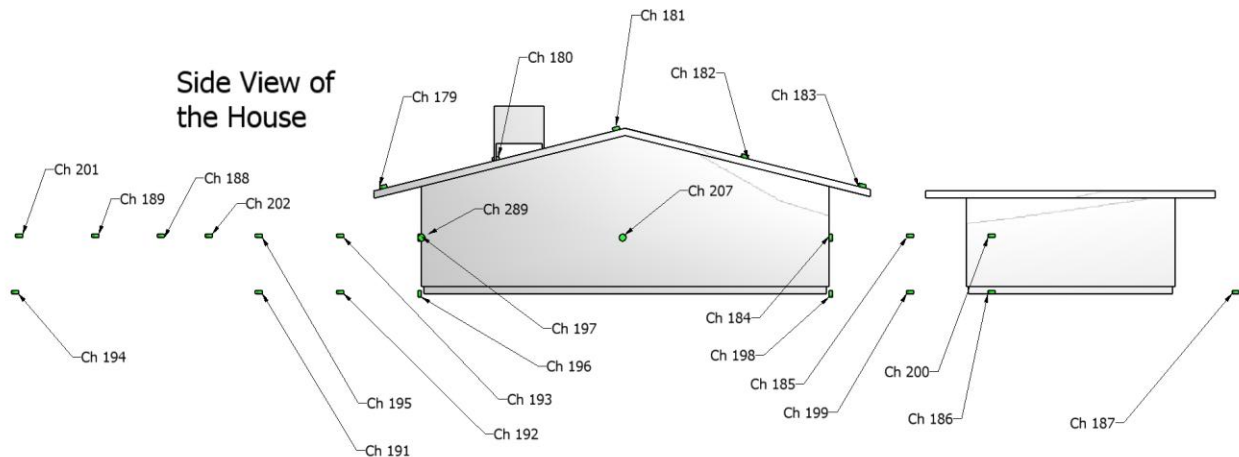
DRAWN	9/20/2006	A	
CHECKED			
QA			
DATE			
APPROVED		Sonic Boom House, Exterior Detail	
		House Isometric views	
		SIZE	REV
		C	
		SCALE	
		SHEET 1 OF 1	

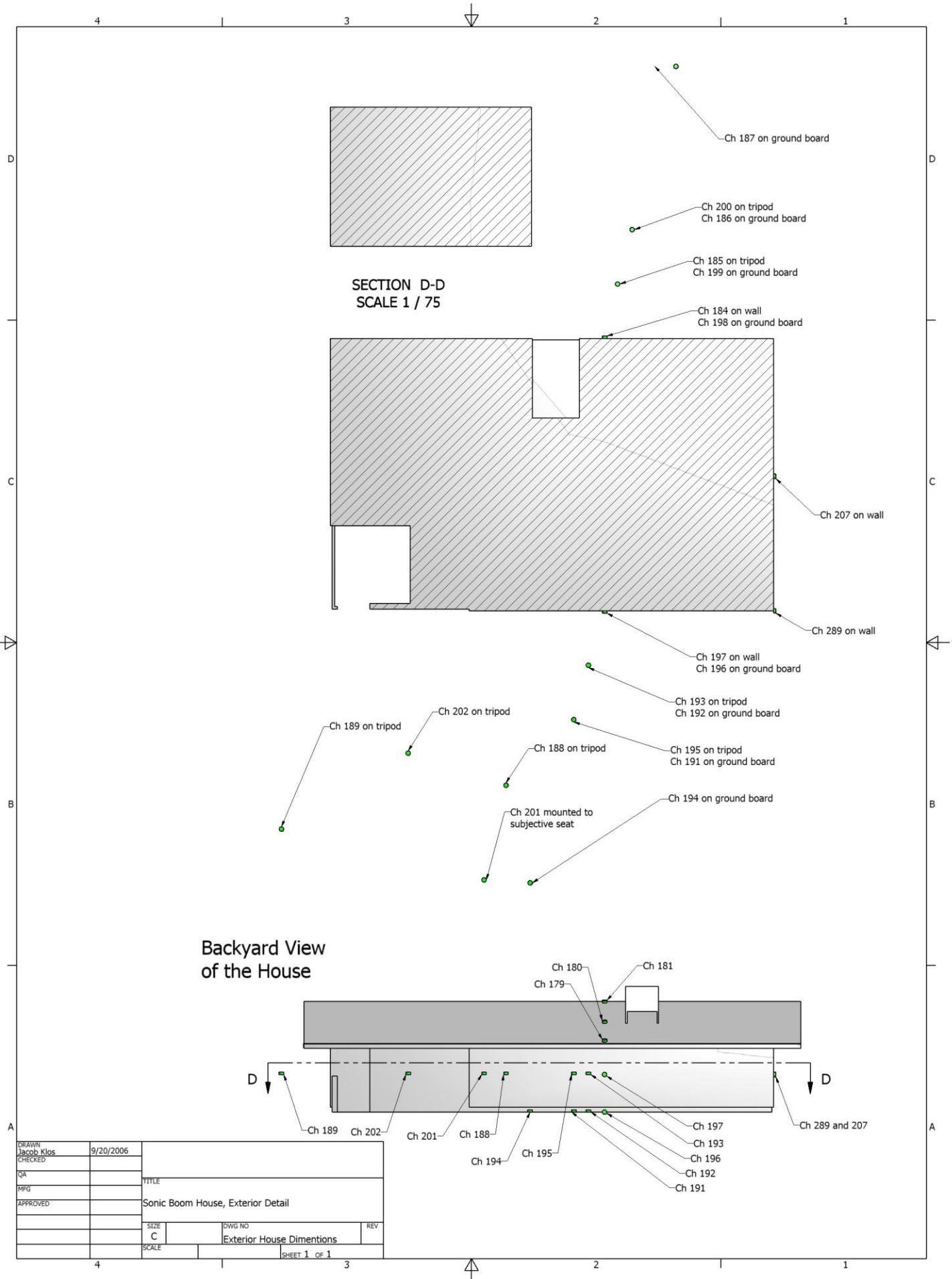
DRAWN Jacob Klos	9/20/2006		
CHECKED			
QA		TITLE	
MFG		Sonic Boom House, Exterior Detail	
APPROVED			
		SIZE C	DWG NO Exterior House Dimensions
		SCALE	REV
			SHEET 1 OF 1

Top View of the House



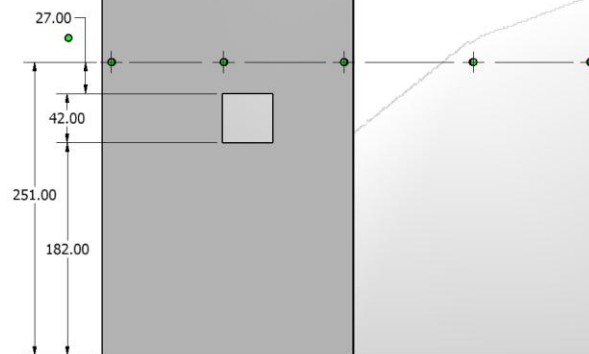
Side View of the House



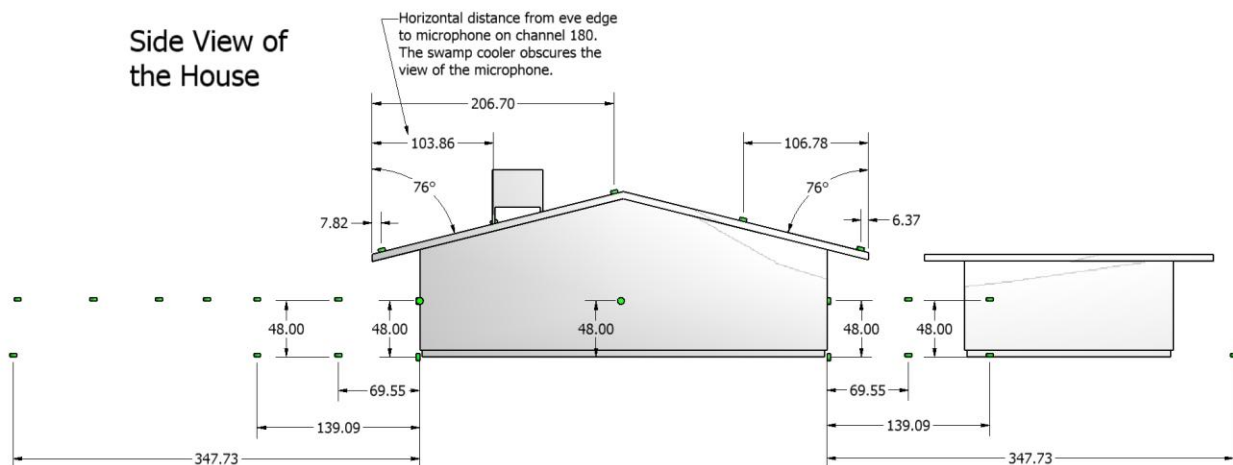


DRAWN Jacob Klos	9/20/2006		
CHECKED			
QA		TITLE	
MFG		Sonic Boom House, Exterior Detail	
APPROVED			
		SIZE C	DWG NO Exterior House Dimensions
		SCALE	REV
			SHEET 1 OF 1

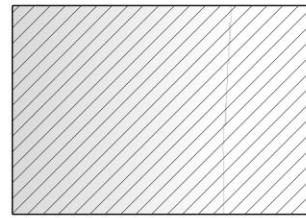
Top View of
the House



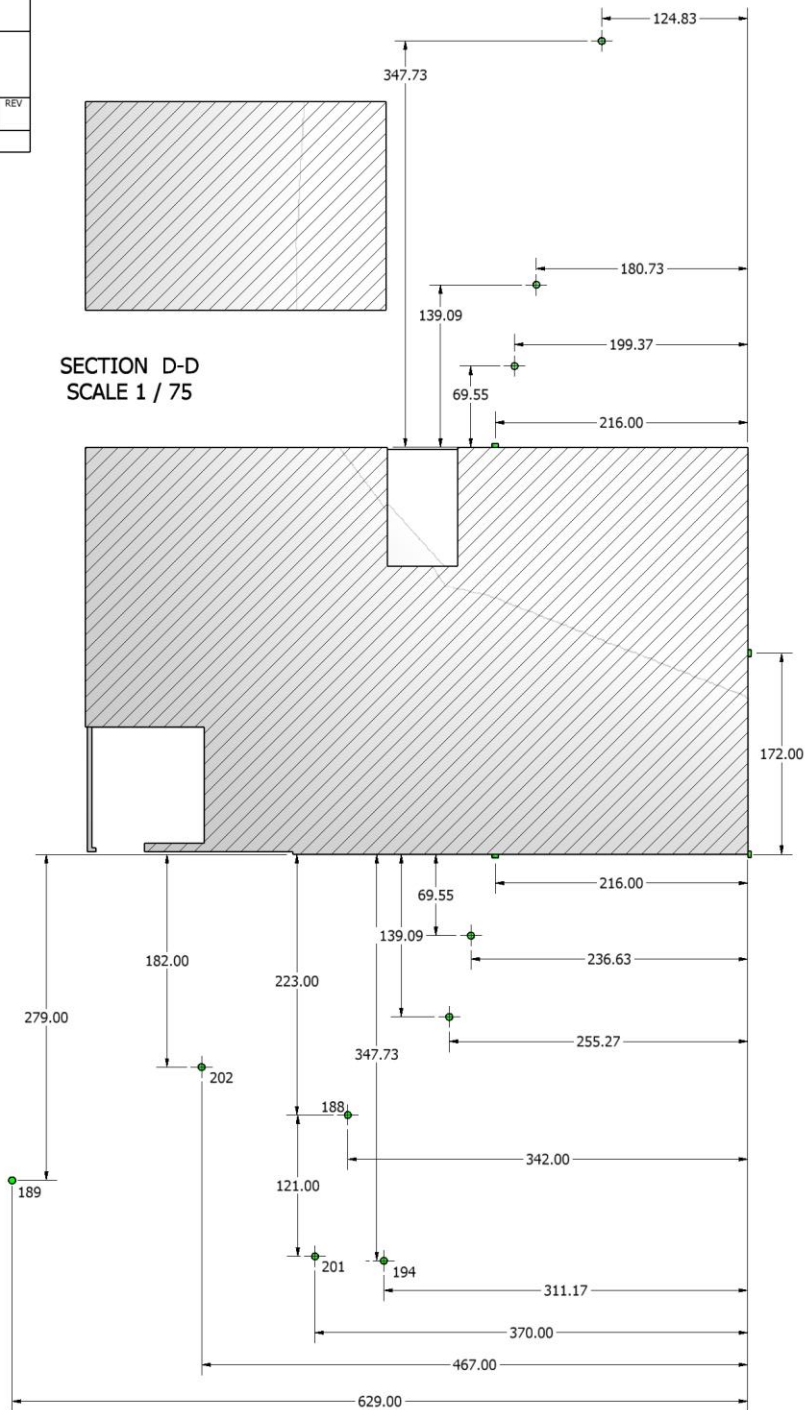
Side View of
the House



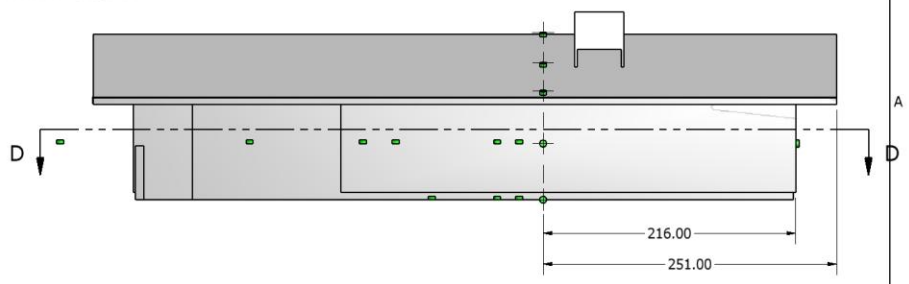
DRAWN Jacob Klos		9/20/2006				3	
CHECKED							
QA				TITLE			
MFG							
APPROVED				Sonic Boom House, Exterior Detail			
		SIZE C		DWG NO Exterior House Dimintions		REV	
		SCALE				SHEET 1 OF 1	

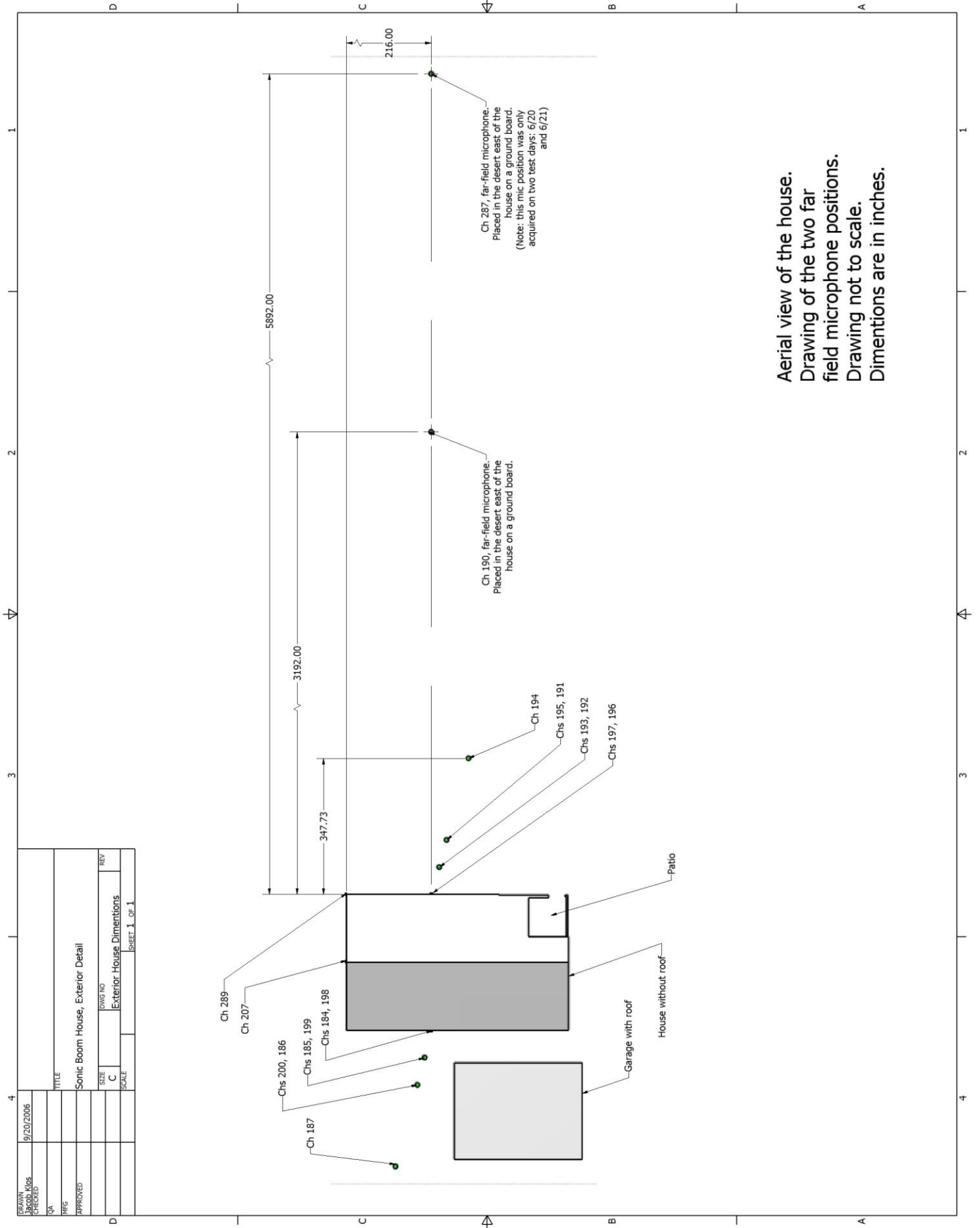


SECTION D-D
SCALE 1 / 75



Backyard View of the House





Aerial view of the house.
Drawing of the two far field microphone positions.
Drawing not to scale.
Dimensions are in inches.

DRAWN	9/20/2006	TITLE	Sonic Boom House, Exterior Detail	
CHECKED	QA	DATE		
APPROVED	WFG	DATE		
SIZE	C	DWG NO	Exterior House Dimensions	
SCALE		REV	SHEET 1 OF 1	

Appendix G

Drawings and pictures of the array microphone locations.

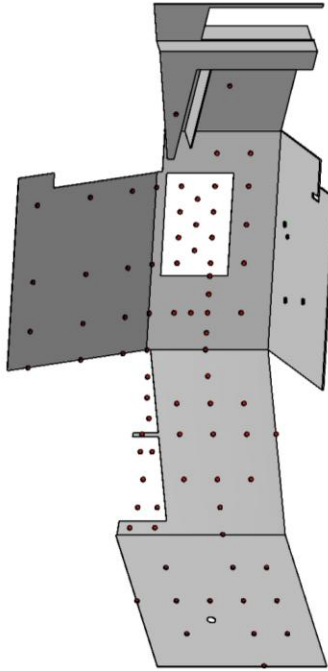
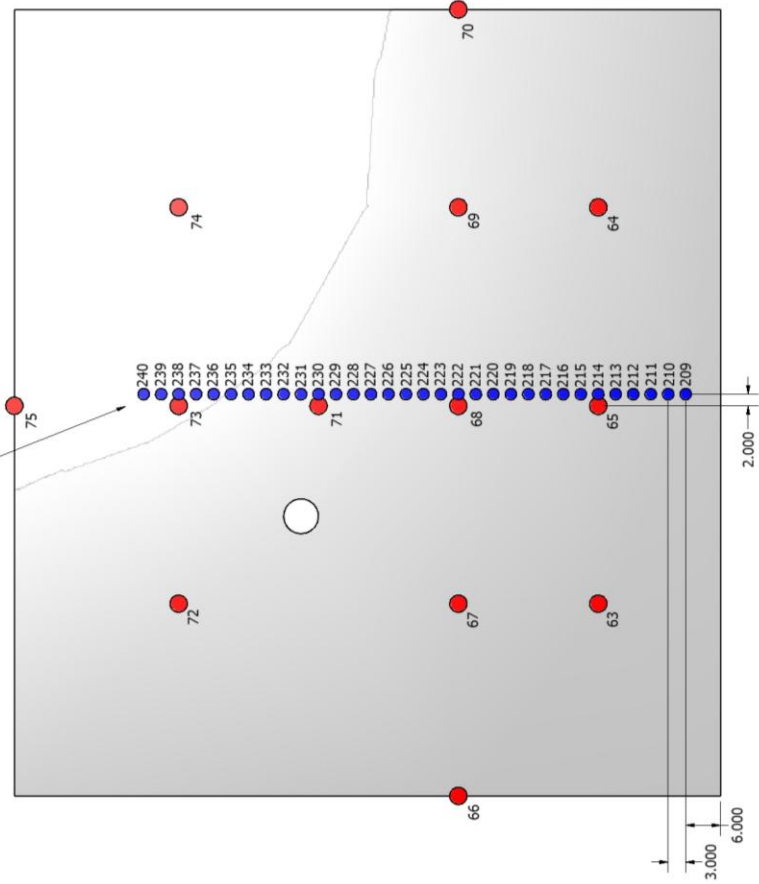
(All dimensions are in inches unless otherwise noted)



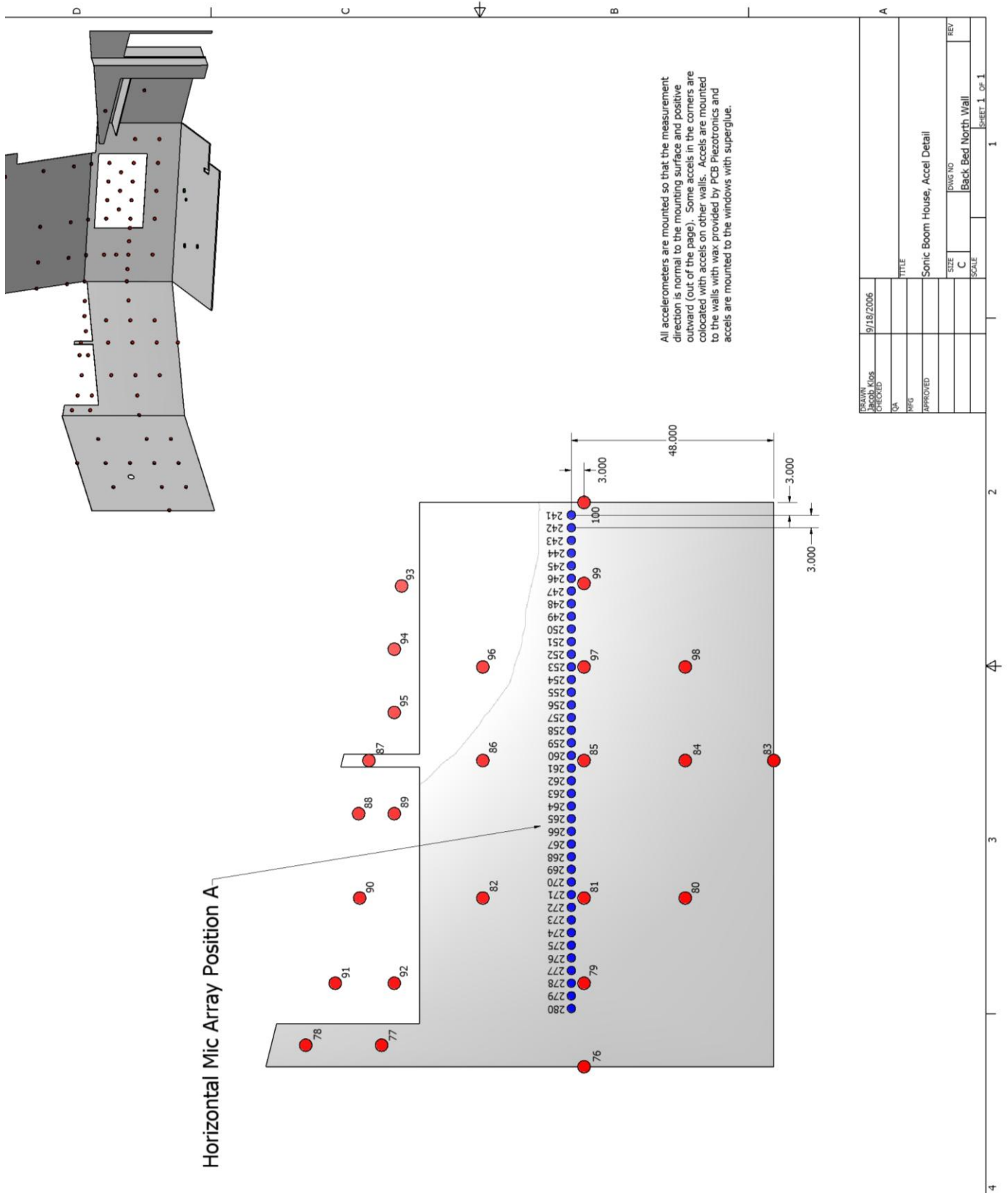
Horizontal and vertical PCB microphone arrays installed on the north wall of the front bedroom. The horizontal array is in Position C and the vertical array is in Position B. The different locations where these arrays were installed throughout the test are illustrated in the following drawings.

All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accelers in the corners are collocated with accelers on other walls. Acceler are mounted to the walls with wax provided by PCB Piezotronics.

Vertical Mic Array Position A-7

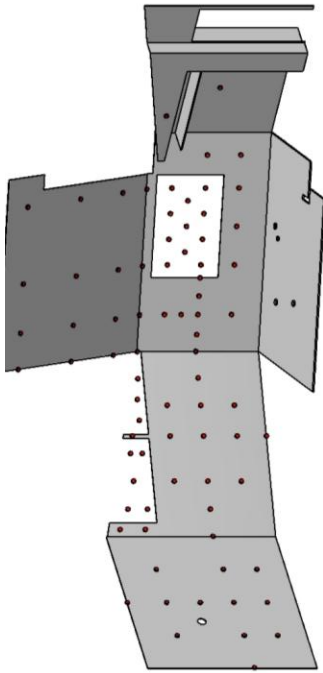
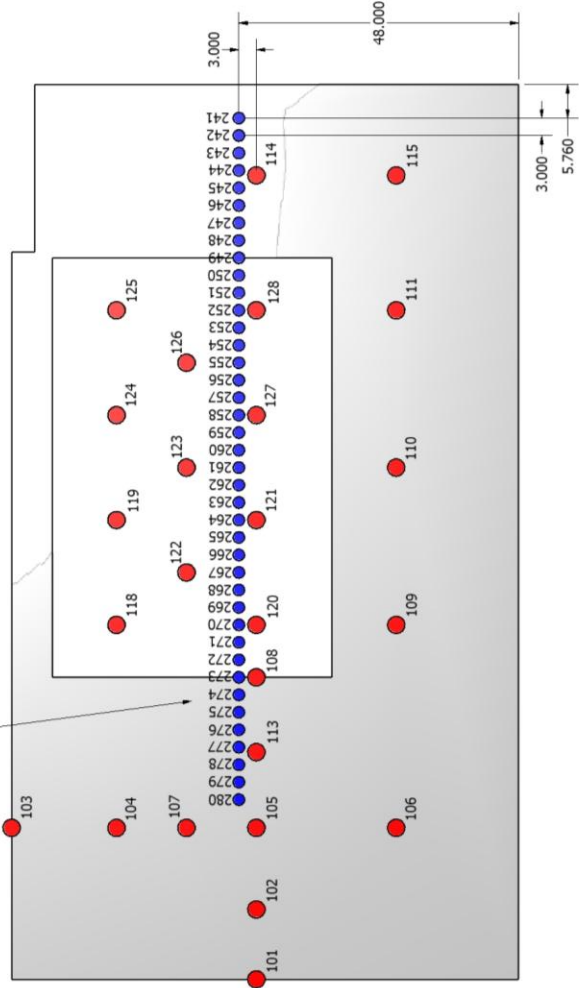


DRAWN BY KOS	9/18/2006
CHECKED	
QA	
MFG	
APPROVED	
TITLE	Sonic Boom House, Accel Detail
SIZE	
C	
SCALE	
DWG NO	Back Bed West Wall
REV	
SHEET 1 OF 1	

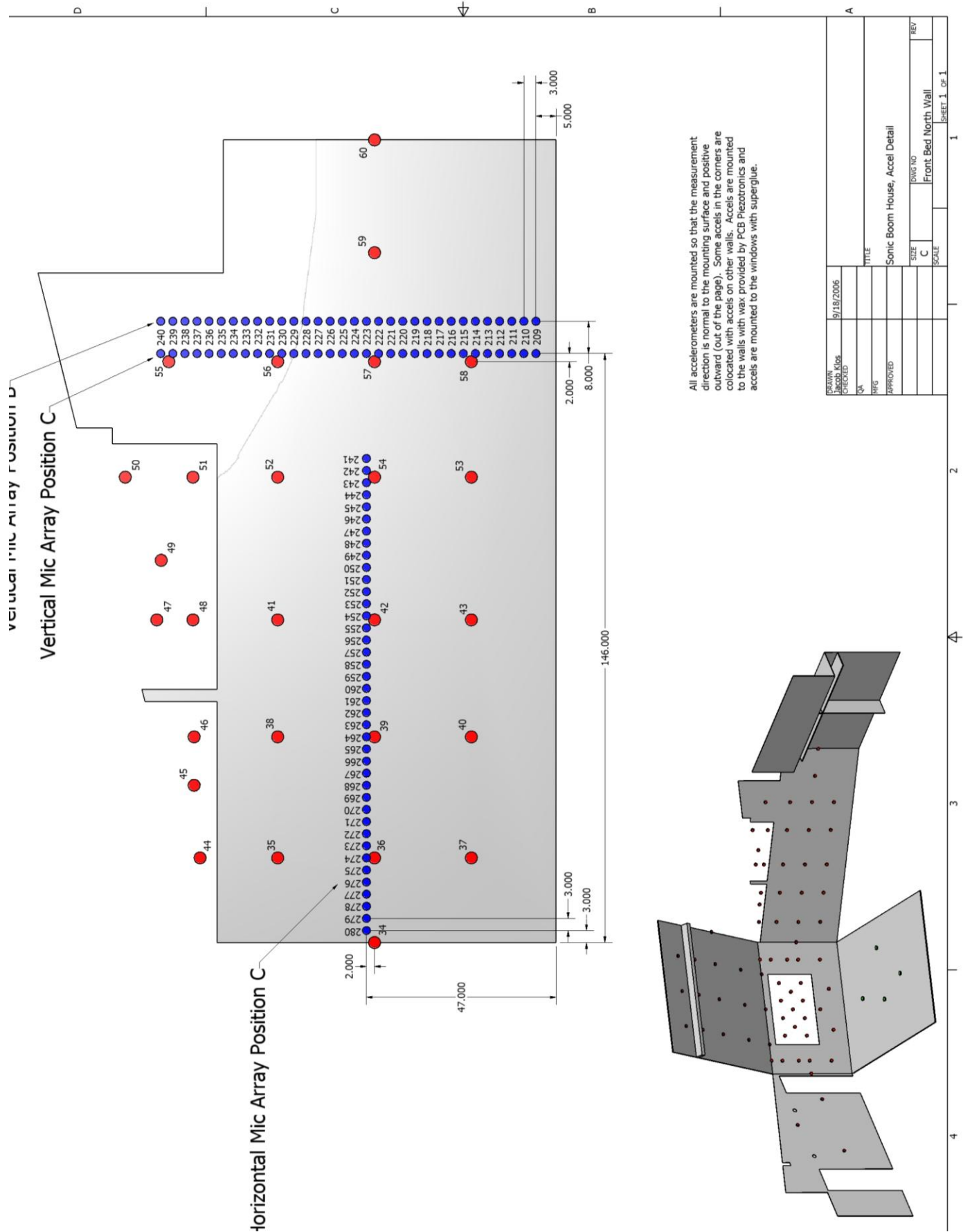


All accelerometers are mounted so that the measurement direction is normal to the mounting surface and positive outward (out of the page). Some accels in the corners are collocated with accels on other walls. Accels are mounted to the walls with wax provided by PCB Piezotronics and accels are mounted to the windows with superglue.

Horizontal Mic Array Position B



DESIGN	9/18/2006				
CHECKED					
DATE					
BY					
APPROVED					
TITLE					
Sonic Boom House, Accel Detail					
SIZE					
C					
SCALE					
Back Bed East Wall					
REV					
1					





Picture of the spherical array in front of the window in the front bedroom.



Picture of the spherical array in front of the window in the front bedroom. The location of the sphere relative to the edge of the window is illustrated in the picture. The sphere center was offset from the glass 8.93 inches from the glass.

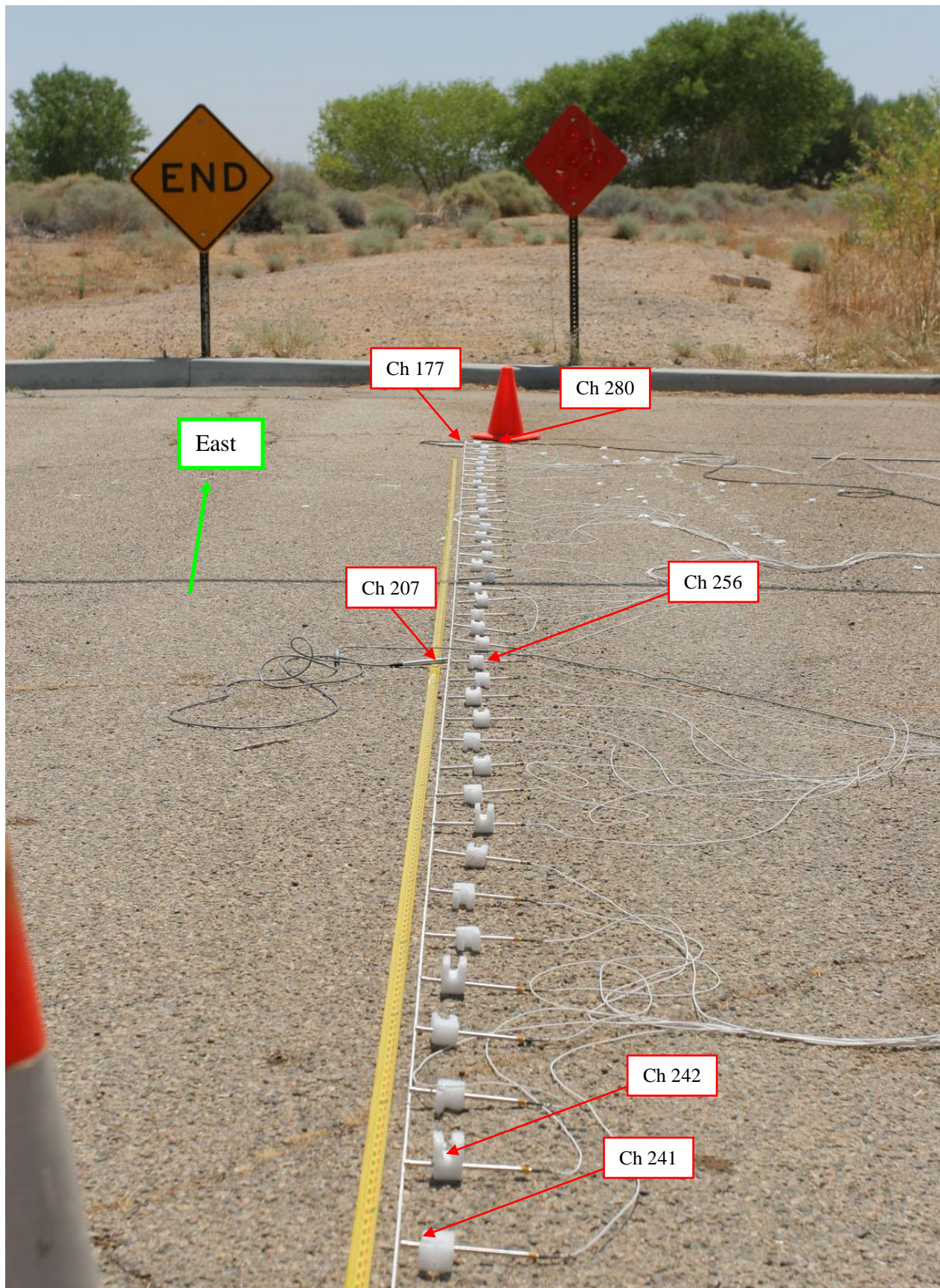
Appendix H

Pictures of the exterior microphone locations on June 22nd.

(All dimensions are in inches unless otherwise noted)



The horizontal microphone array of PCB series-130 microphones was disassembled on June 22nd and the 40 PCB array microphones were placed outside on the roadway just north of the test house. This is a photo of the array lying on the ground. The view above is looking south towards the test house at 7334 Andrews Ave. More photos follow.



The array runs east-west, the view above is looking east. The western most microphone is on channel 241 and the eastern most microphone is on channel 280.

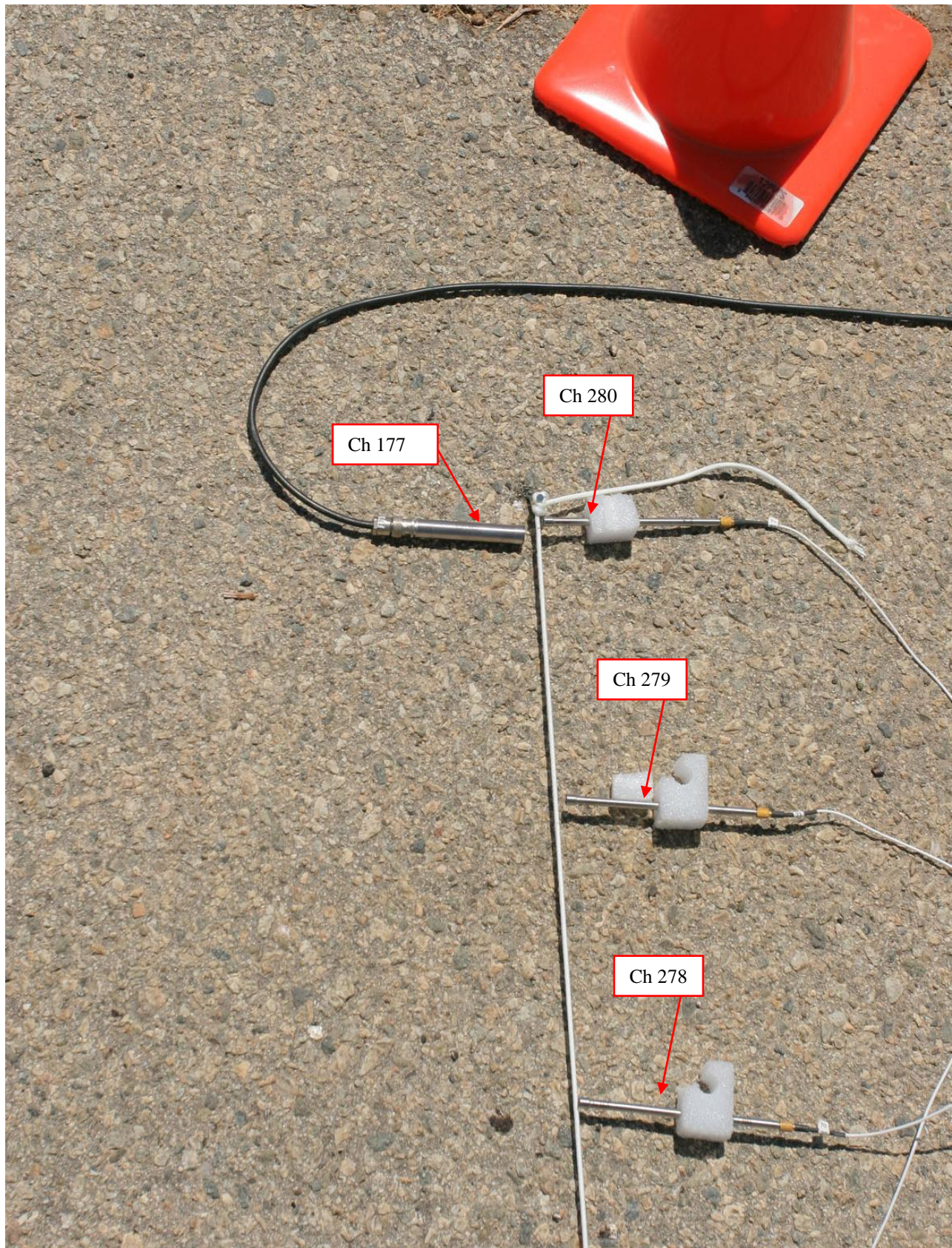


Photo of the east most microphone, the Gras microphone on channel 177 was collocated with the array microphone connected to channel 280 for a reference.

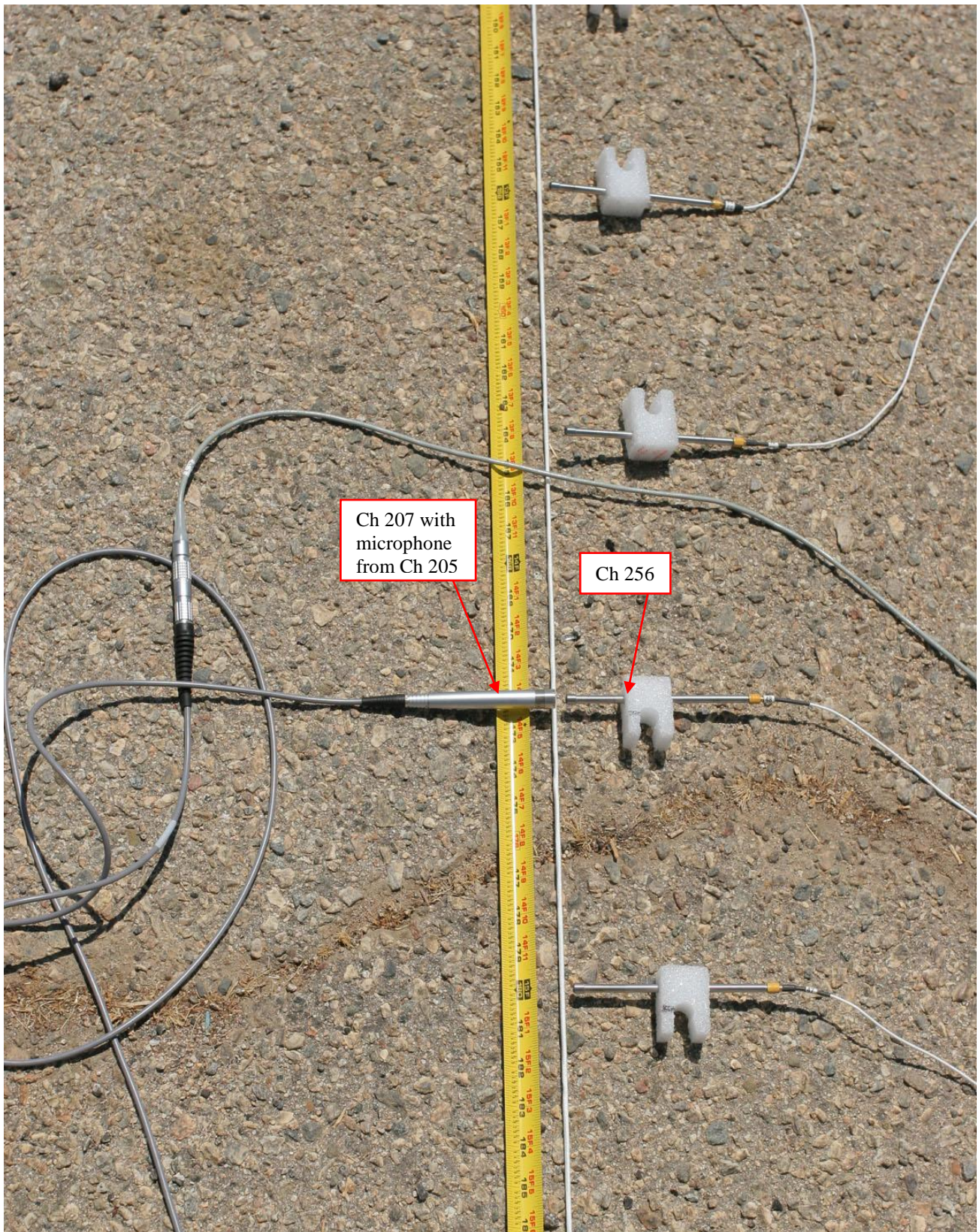


Photo of array microphones in the middle of the array. A Brüel and Kjær 4193 microphone from channel 205 was connected to channel 207 and was collocated with the array microphone on channel 256 as a reference.

Order of the microphones from west to east in the PCB array on the 22nd

241 Western most microphone

242

244 Reversed order

243

245

246

247

248

249

250

251

252

253

254

255

256 Collocated with channel 207

257

259 Reversed order

258

260

261

262

263

264

265

266

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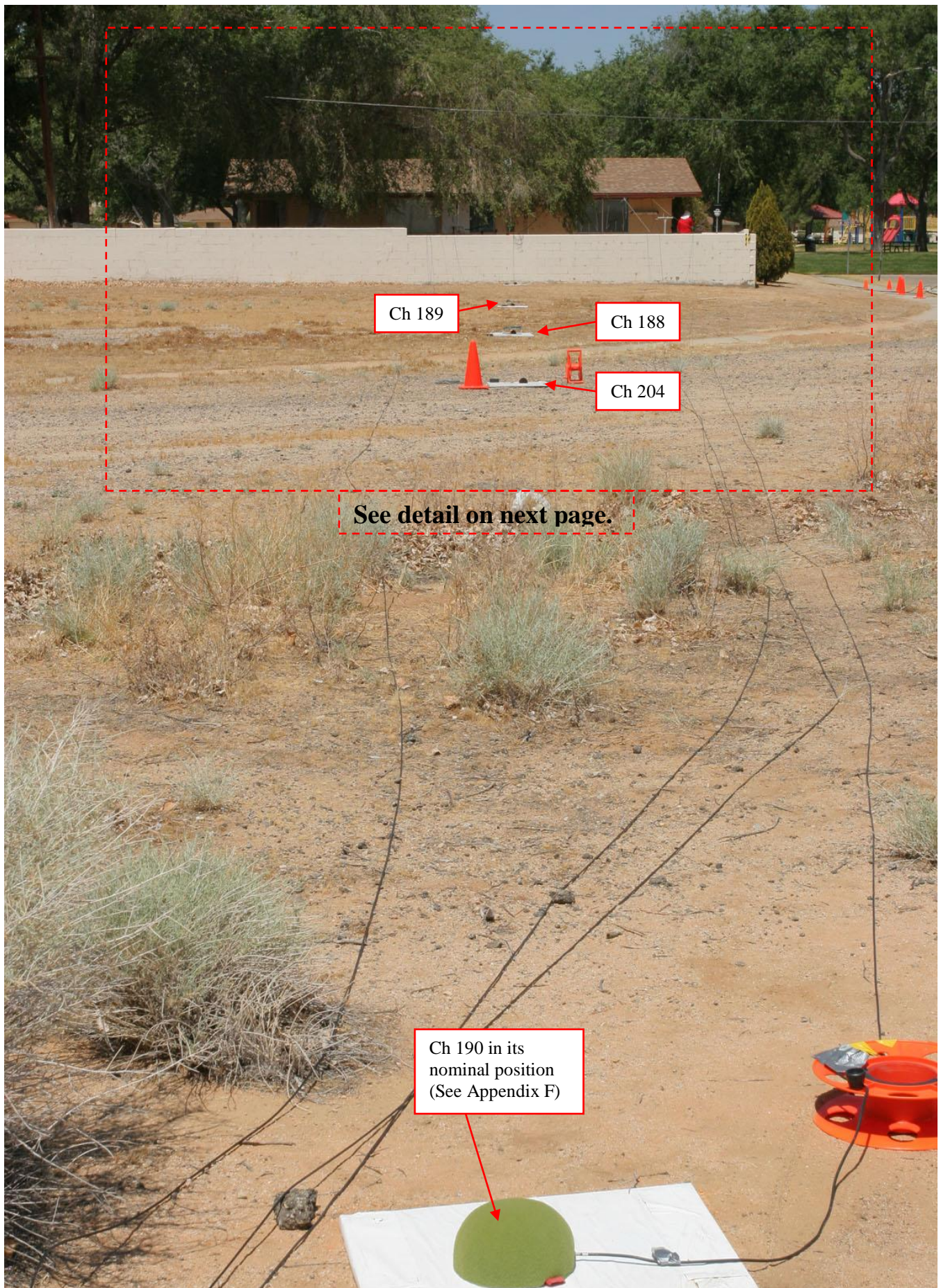
279

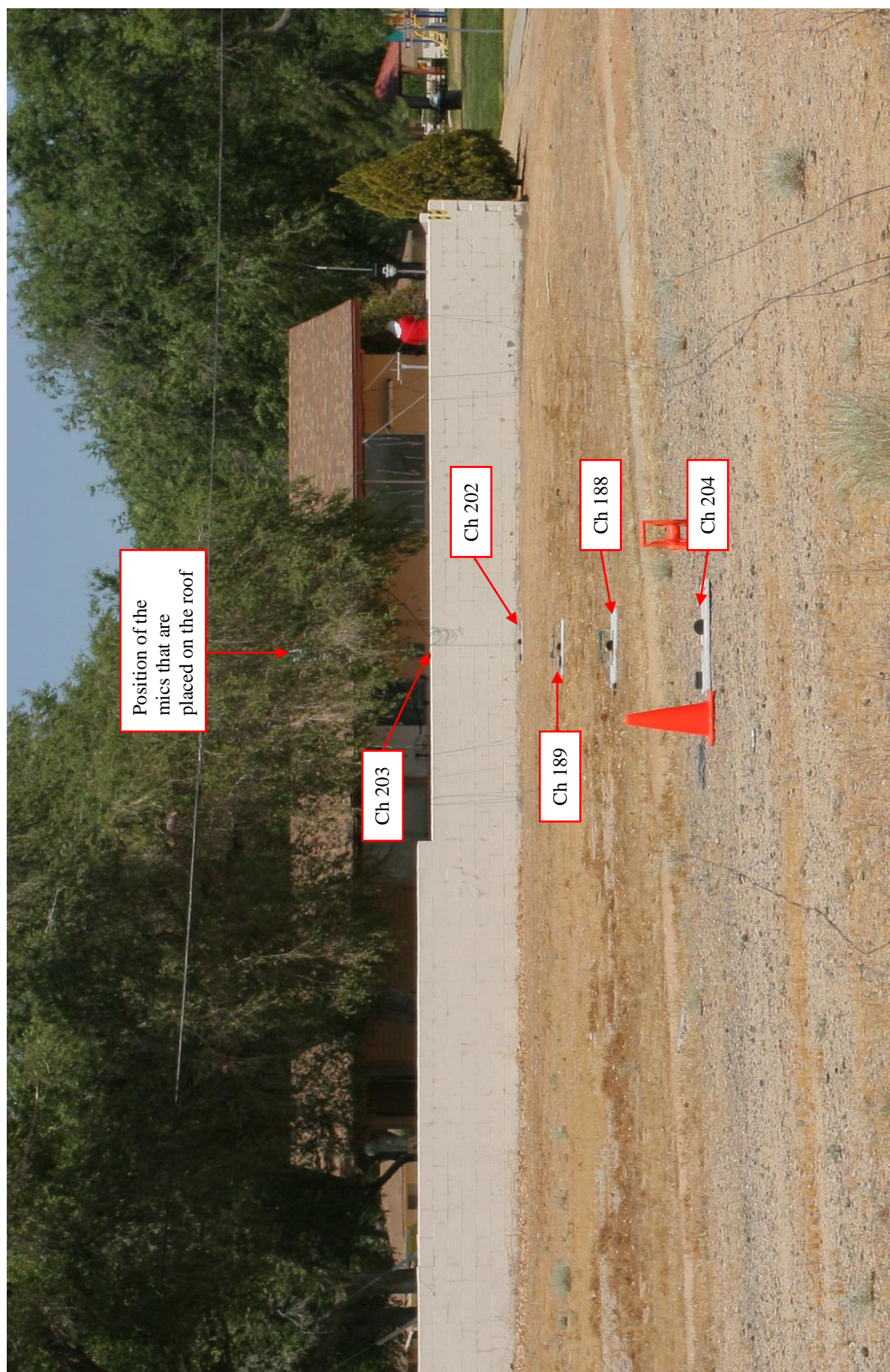
280 Eastern most microphone, collocated with channel 177



Picture of the three microphones placed near the fence on June 22nd. The two microphones on the ground are 3 feet from the fence surface.







The line formed by these microphones roughly lined up with the array of microphones that was placed on the roof. Channels 189, 188, and 204 were roughly 115' 10", 155' 5", and 195' 8" from the back wall of the house.

Appendix I

Daily atmospheric profiles and backyard weather station data.

Backyard weather station data

Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir	Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir
6	13	6	9	30	72.3	30	4.3	293	6	13	6	10	46	73.3	28	4.3	293
6	13	6	9	31	72.3	30	3.5	270	6	13	6	10	47	73.3	28	4.3	293
6	13	6	9	32	72.3	30	4.3	293	6	13	6	10	48	73.5	28	3.5	293
6	13	6	9	33	72.3	31	5.2	315	6	13	6	10	49	73.7	29	4.3	315
6	13	6	9	34	72.5	30	5.2	315	6	13	6	10	50	73.9	29	4.3	293
6	13	6	9	35	72.5	29	4.3	293	6	13	6	10	51	73.9	29	6.1	253
6	13	6	9	36	72.5	30	4.3	315	6	13	6	10	52	73.9	27	6.1	315
6	13	6	9	37	72.7	31	4.3	360	6	13	6	10	53	74.0	28	6.1	338
6	13	6	9	38	72.7	31	4.3	253	6	13	6	10	54	74.0	28	10.4	315
6	13	6	9	39	72.7	30	2.6	293	6	13	6	10	55	74.2	29	4.3	293
6	13	6	9	40	72.7	30	2.6	293	6	13	6	10	56	74.2	28	5.2	293
6	13	6	9	41	72.7	29	4.3	293	6	13	6	10	57	74.2	28	5.2	293
6	13	6	9	42	72.7	29	2.6	293	6	13	6	10	58	74.2	28	5.2	293
6	13	6	9	43	72.8	29	3.5	293	6	13	6	10	59	74.2	28	7.8	315
6	13	6	9	44	73.0	30	5.2	293	6	13	6	11	0	74.2	28	4.3	293
6	13	6	9	45	73.0	32	7.0	315	6	13	6	11	1	74.0	28	5.2	293
6	13	6	9	46	73.0	31	5.2	315	6	13	6	11	2	74.0	29	6.1	338
6	13	6	9	47	73.0	32	4.3	315	6	13	6	11	3	74.0	30	5.2	338
6	13	6	9	48	73.2	31	4.3	270	6	13	6	11	4	74.2	29	6.1	293
6	13	6	9	49	73.0	30	7.8	293	6	13	6	11	5	74.4	28	3.5	293
6	13	6	9	50	73.0	31	5.2	360	6	13	6	11	6	74.4	28	2.6	293
6	13	6	9	51	72.8	30	5.2	293	6	13	6	11	7	74.4	28	3.5	293
6	13	6	9	52	72.8	30	7.8	315	6	13	6	11	8	74.4	28	8.7	293
6	13	6	9	53	72.7	30	6.1	315	6	13	6	11	9	74.2	27	10.4	315
6	13	6	9	54	72.5	31	3.5	315	6	13	6	11	10	74.0	27	7.8	315
6	13	6	9	55	72.7	31	6.1	360	6	13	6	11	11	74.0	28	7.0	338
6	13	6	9	56	72.7	31	5.2	338	6	13	6	11	12	74.0	27	5.2	293
6	13	6	9	57	72.7	31	6.1	293	6	13	6	11	13	74.0	27	6.1	293
6	13	6	9	58	72.7	30	3.5	315	6	13	6	11	14	74.0	28	6.1	315
6	13	6	9	59	72.8	31	6.1	360	6	13	6	11	15	74.0	28	8.7	293
6	13	6	10	0	72.7	30	7.8	360	6	13	6	11	16	74.0	27	8.7	315
6	13	6	10	1	72.7	30	7.0	315	6	13	6	11	17	74.0	27	5.2	315
6	13	6	10	2	72.8	30	2.6	338	6	13	6	11	18	74.2	27	6.1	360
6	13	6	10	3	72.8	28	6.1	315	6	13	6	11	19	74.2	28	7.0	293
6	13	6	10	4	72.8	29	6.1	315	6	13	6	11	20	74.2	27	6.1	293
6	13	6	10	5	72.8	27	5.2	315	6	13	6	11	21	74.4	27	4.3	253
6	13	6	10	6	72.8	28	4.3	293	6	13	6	11	22	74.4	27	7.8	315
6	13	6	10	7	72.8	28	4.3	293	6	13	6	11	23	74.6	27	2.6	315
6	13	6	10	8	NaN	28	0.0	NaN	6	13	6	11	24	74.7	28	3.5	315
6	13	6	10	9	72.7	29	6.1	338	6	13	6	11	25	74.9	28	3.5	293
6	13	6	10	10	72.7	30	3.5	338	6	13	6	11	26	75.1	26	4.3	270
6	13	6	10	11	72.7	30	4.3	360	6	13	6	11	27	75.1	25	3.5	293
6	13	6	10	12	72.8	29	3.5	338	6	13	6	11	28	75.3	26	6.1	293
6	13	6	10	13	73.0	29	4.3	360	6	13	6	11	29	75.3	26	4.3	293
6	13	6	10	14	73.2	29	6.1	360	6	13	6	11	30	75.3	26	2.6	315
6	13	6	10	15	73.3	27	4.3	293	6	13	6	11	31	75.3	26	1.7	293
6	13	6	10	16	73.3	28	4.3	293	6	13	6	11	32	75.3	25	3.5	293
6	13	6	10	17	73.3	29	6.1	338	6	13	6	11	33	75.4	25	3.5	293
6	13	6	10	18	73.3	29	7.0	315	6	13	6	11	34	75.4	25	6.1	293
6	13	6	10	19	73.3	27	5.2	293	6	13	6	11	35	75.4	24	7.0	293
6	13	6	10	20	73.3	29	3.5	315	6	13	6	11	36	75.4	25	7.0	338
6	13	6	10	21	73.5	28	2.6	293	6	13	6	11	37	75.4	24	4.3	270
6	13	6	10	22	73.7	28	5.2	293	6	13	6	11	38	75.3	23	6.1	253
6	13	6	10	23	73.5	27	7.0	315	6	13	6	11	39	75.3	23	5.2	293
6	13	6	10	24	73.5	28	6.1	338	6	13	6	11	40	75.1	23	5.2	293
6	13	6	10	25	73.5	28	5.2	270	6	13	6	11	41	75.3	23	3.5	293
6	13	6	10	26	73.5	28	3.5	293	6	13	6	11	42	75.3	23	4.3	293
6	13	6	10	27	73.5	27	5.2	315	6	13	6	11	43	75.4	24	7.0	293
6	13	6	10	28	73.5	27	2.6	293	6	13	6	11	44	75.4	24	7.0	360
6	13	6	10	29	73.7	28	5.2	360	6	13	6	11	45	75.4	24	7.8	315
6	13	6	10	30	73.7	28	6.1	293	6	13	6	11	46	75.6	22	9.6	293
6	13	6	10	31	73.7	28	3.5	270	6	13	6	11	47	75.6	22	4.3	338
6	13	6	10	32	73.5	28	6.1	293	6	13	6	11	48	75.8	24	3.5	338
6	13	6	10	33	73.5	28	3.5	293	6	13	6	11	49	76.0	24	4.3	270
6	13	6	10	34	73.5	27	4.3	293	6	13	6	11	50	76.0	22	3.5	315
6	13	6	10	35	73.5	28	4.3	315	6	13	6	11	51	76.1	22	4.3	293
6	13	6	10	36	73.5	28	6.1	293	6	13	6	11	52	76.3	21	6.1	293
6	13	6	10	37	73.5	29	6.1	293	6	13	6	11	53	76.5	20	5.2	293
6	13	6	10	38	73.7	28	5.2	315	6	13	6	11	54	76.5	21	6.1	293
6	13	6	10	39	73.7	28	9.6	293	6	13	6	11	55	76.5	24	5.2	315
6	13	6	10	40	73.5	28	5.2	293	6	13	6	11	56	76.5	22	7.0	293

Backyard weather station data

Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir
6	15	6	10	30	79.8	24	6.1	293
6	15	6	10	31	79.6	24	5.2	360
6	15	6	10	32	79.8	26	5.2	360
6	15	6	10	33	79.9	25	5.2	360
6	15	6	10	34	80.1	24	6.1	315
6	15	6	10	35	80.1	23	4.3	293
6	15	6	10	36	80.1	23	7.8	293
6	15	6	10	37	79.9	24	5.2	360
6	15	6	10	38	79.9	24	4.3	360
6	15	6	10	39	80.1	24	5.2	338
6	15	6	10	40	80.1	24	3.5	338
6	15	6	10	41	80.3	23	7.0	338
6	15	6	10	42	80.3	23	3.5	293
6	15	6	10	43	80.3	23	4.3	293
6	15	6	10	44	80.1	22	5.2	270
6	15	6	10	45	80.1	23	7.0	315
6	15	6	10	46	80.1	23	6.1	360
6	15	6	10	47	80.1	23	7.0	315
6	15	6	10	48	79.9	23	6.1	315
6	15	6	10	49	80.1	23	4.3	315
6	15	6	10	50	80.1	24	7.0	315
6	15	6	10	51	80.1	23	6.1	338
6	15	6	10	52	80.1	22	7.0	360
6	15	6	10	53	80.1	23	5.2	338
6	15	6	10	54	80.3	24	6.1	338
6	15	6	10	55	80.3	23	6.1	315
6	15	6	10	56	80.5	22	4.3	293
6	15	6	10	57	80.5	23	4.3	338
6	15	6	10	58	80.5	22	4.3	293
6	15	6	10	59	80.5	22	4.3	270
6	15	6	11	0	80.7	23	2.6	360
6	15	6	11	1	80.7	22	3.5	360
6	15	6	11	2	80.9	23	4.3	360
6	15	6	11	3	80.9	22	4.3	293
6	15	6	11	4	81.1	22	2.6	338
6	15	6	11	5	81.1	22	4.3	23
6	15	6	11	6	81.2	23	5.2	360
6	15	6	11	7	81.4	22	5.2	315
6	15	6	11	8	81.4	22	4.3	315
6	15	6	11	9	81.6	22	5.2	315
6	15	6	11	10	81.6	22	5.2	293
6	15	6	11	11	81.4	21	6.1	338
6	15	6	11	12	81.4	21	5.2	360
6	15	6	11	13	81.4	21	4.3	338
6	15	6	11	14	81.4	21	3.5	315
6	15	6	11	15	81.6	22	6.1	293
6	15	6	11	16	81.6	23	4.3	315
6	15	6	11	17	81.8	23	3.5	293
6	15	6	11	18	81.8	21	4.3	315
6	15	6	11	19	82.0	21	4.3	293
6	15	6	11	20	82.0	21	4.3	338
6	15	6	11	21	82.0	22	3.5	315
6	15	6	11	22	82.0	21	6.1	293
6	15	6	11	23	82.0	21	4.3	360
6	15	6	11	24	82.0	22	5.2	338
6	15	6	11	25	82.0	23	6.1	360
6	15	6	11	26	82.0	22	6.1	360
6	15	6	11	27	82.0	21	5.2	315
6	15	6	11	28	82.0	21	6.1	360
6	15	6	11	29	82.2	21	4.3	360
6	15	6	11	30	82.2	22	4.3	315
6	15	6	11	31	82.4	21	5.2	360
6	15	6	11	32	82.4	21	6.1	360
6	15	6	11	33	82.4	22	6.1	293
6	15	6	11	34	82.2	21	6.1	293
6	15	6	11	35	82.2	21	7.0	315
6	15	6	11	36	82.0	22	7.0	360
6	15	6	11	37	82.0	22	5.2	360
6	15	6	11	38	82.2	22	6.1	360
6	15	6	11	39	82.2	22	6.1	315
6	15	6	11	40	82.2	22	6.1	338

Backyard weather station data

Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir	Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir
6	16	6	9	30	82.6	19	0.9	113	6	16	6	11	1	87.2	15	2.6	135
6	16	6	9	31	82.8	20	1.7	90	6	16	6	11	2	87.8	14	6.1	135
6	16	6	9	32	83.0	19	1.7	23	6	16	6	11	3	88.2	13	5.2	180
6	16	6	9	33	83.0	20	0.9	23	6	16	6	11	4	88.2	13	5.2	180
6	16	6	9	34	83.4	19	2.6	113	6	16	6	11	5	88.0	13	3.5	180
6	16	6	9	35	83.6	18	4.3	113	6	16	6	11	6	88.0	13	6.1	180
6	16	6	9	36	83.8	18	1.7	113	6	16	6	11	7	88.0	13	4.3	135
6	16	6	9	37	83.8	19	1.7	45	6	16	6	11	8	88.2	14	4.3	113
6	16	6	9	38	84.0	18	1.7	45	6	16	6	11	9	88.4	13	6.1	208
6	16	6	9	39	84.0	18	1.7	113	6	16	6	11	10	88.0	13	4.3	208
6	16	6	9	40	84.1	17	1.7	113	6	16	6	11	11	87.8	13	4.3	113
6	16	6	9	41	84.1	17	1.7	68	6	16	6	11	12	87.8	14	2.6	135
6	16	6	9	42	84.3	18	1.7	113	6	16	6	11	13	88.0	14	4.3	90
6	16	6	9	43	84.5	17	2.6	68	6	16	6	11	14	88.0	13	7.0	180
6	16	6	9	44	84.5	16	2.6	113	6	16	6	11	15	88.0	13	7.0	180
6	16	6	9	45	84.7	16	1.7	135	6	16	6	11	16	88.0	13	5.2	158
6	16	6	9	46	84.7	17	2.6	360	6	16	6	11	17	88.2	14	3.5	135
6	16	6	9	47	84.7	19	1.7	23	6	16	6	11	18	88.6	13	5.2	135
6	16	6	9	48	84.9	17	3.5	135	6	16	6	11	19	88.6	13	5.2	180
6	16	6	9	49	84.7	16	2.6	113	6	16	6	11	20	88.4	13	8.7	208
6	16	6	9	50	84.9	17	0.9	113	6	16	6	11	21	88.2	13	6.1	180
6	16	6	9	51	85.1	18	3.5	90	6	16	6	11	22	88.2	13	6.1	135
6	16	6	9	52	85.1	16	4.3	135	6	16	6	11	23	88.4	12	5.2	135
6	16	6	9	53	85.3	17	2.6	135	6	16	6	11	24	88.8	12	5.2	135
6	16	6	9	54	85.3	16	2.6	90	6	16	6	11	25	89.0	12	5.2	158
6	16	6	9	55	85.5	16	1.7	135	6	16	6	11	26	89.3	12	4.3	180
6	16	6	9	56	85.7	15	5.2	135	6	16	6	11	27	89.3	12	4.3	158
6	16	6	9	57	85.7	15	4.3	135	6	16	6	11	28	89.3	12	5.2	180
6	16	6	9	58	85.9	15	2.6	135	6	16	6	11	29	89.0	12	1.7	158
6	16	6	9	59	86.1	16	1.7	113	6	16	6	11	30	89.0	12	2.6	158
6	16	6	10	0	86.1	16	5.2	158	6	16	6	11	31	88.8	12	2.6	208
6	16	6	10	1	86.3	16	3.5	135	6	16	6	11	32	88.8	13	4.3	90
6	16	6	10	2	86.3	16	3.5	113	6	16	6	11	33	89.0	13	2.6	113
6	16	6	10	3	86.3	15	3.5	135	6	16	6	11	34	89.3	13	5.2	208
6	16	6	10	4	86.5	15	3.5	158	6	16	6	11	35	89.3	12	7.8	208
6	16	6	10	5	86.5	15	2.6	135	6	16	6	11	36	89.0	13	7.8	208
6	16	6	10	6	86.5	15	6.1	180	6	16	6	11	37	88.8	13	3.5	208
6	16	6	10	7	86.5	16	4.3	180	6	16	6	11	38	88.6	12	7.0	180
6	16	6	10	8	86.1	16	4.3	180	6	16	6	11	39	88.8	12	6.1	158
6	16	6	10	9	85.9	16	6.1	180	6	16	6	11	40	88.8	12	6.1	180
6	16	6	10	10	85.5	16	6.1	180	6	16	6	11	41	89.3	12	6.1	113
6	16	6	10	11	85.5	16	5.2	158	6	16	6	11	42	89.7	12	5.2	158
6	16	6	10	12	85.3	16	6.1	180	6	16	6	11	43	89.9	11	7.8	135
6	16	6	10	13	85.3	16	4.3	180	6	16	6	11	44	89.9	11	7.0	158
6	16	6	10	14	85.3	16	3.5	135	6	16	6	11	45	89.9	11	5.2	158
6	16	6	10	15	85.3	16	7.0	158	6	16	6	11	46	89.9	11	3.5	135
6	16	6	10	16	85.5	16	7.0	135	6	16	6	11	47	89.9	11	4.3	45
6	16	6	10	17	85.7	16	6.1	158	6	16	6	11	48	90.1	11	1.7	113
6	16	6	10	18	86.1	15	3.5	208	6	16	6	11	49	90.3	12	1.7	68
6	16	6	10	19	86.1	15	3.5	158	6	16	6	11	50	90.3	14	4.3	360
6	16	6	10	20	86.1	16	5.2	158	6	16	6	11	51	90.3	12	2.6	360
6	16	6	10	21	86.1	16	1.7	180	6	16	6	11	52	90.3	12	0.9	45
6	16	6	10	22	86.3	16	4.3	90	6	16	6	11	53	90.5	11	2.6	135
6	16	6	10	23	86.3	16	2.6	68	6	16	6	11	54	90.5	11	4.3	135
6	16	6	10	24	86.3	16	3.5	113	6	16	6	11	55	90.7	11	4.3	113
6	16	6	10	25	86.5	15	5.2	180	6	16	6	11	56	91.0	11	2.6	90
6	16	6	10	26	86.5	15	4.3	208	6	16	6	11	57	91.0	11	3.5	45
6	16	6	10	27	86.1	15	5.2	208	6	16	6	11	58	90.7	11	3.5	158
6	16	6	10	28	86.1	16	6.1	158	6	16	6	11	59	90.7	11	6.1	135
6	16	6	10	29	86.1	16	7.0	180	6	16	6	12	0	91.0	10	5.2	113
6	16	6	10	30	85.9	16	4.3	180	6	16	6	12	1	91.2	11	5.2	135
6	16	6	10	31	85.9	16	5.2	180	6	16	6	12	2	91.4	10	2.6	113
6	16	6	10	32	85.9	16	5.2	208	6	16	6	12	3	91.4	10	3.5	135
6	16	6	10	33	85.5	16	3.5	208	6	16	6	12	4	91.2	11	3.5	158
6	16	6	10	34	85.5	16	4.3	180	6	16	6	12	5	91.2	11	4.3	135
6	16	6	10	35	85.7	16	4.3	180	6	16	6	12	6	91.4	11	7.0	135
6	16	6	10	36	85.9	16	5.2	158	6	16	6	12	7	91.6	10	5.2	135
6	16	6	10	37	85.9	16	3.5	180	6	16	6	12	8	91.8	10	4.3	135
6	16	6	10	38	85.9	15	1.7	180	6	16	6	12	9	92.3	10	6.1	135
6	16	6	10	39	85.9	15	2.6	180	6	16	6	12	10	92.5	10	7.0	158
6	16	6	10	40	86.1	15	0.9	180	6	16	6	12	11	92.3	10	7.0	135

Backyard weather station data

Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir	Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir
6	20	6	9	30	82.6	16	7.8	315	6	20	6	11	1	90.1	9	1.7	293
6	20	6	9	31	82.6	16	2.6	338	6	20	6	11	2	90.1	8	3.5	338
6	20	6	9	32	82.6	16	3.5	293	6	20	6	11	3	90.1	8	2.6	338
6	20	6	9	33	82.6	16	1.7	270	6	20	6	11	4	90.1	9	5.2	315
6	20	6	9	34	82.8	16	1.7	293	6	20	6	11	5	90.1	8	2.6	293
6	20	6	9	35	82.6	16	4.3	293	6	20	6	11	6	90.1	9	1.7	293
6	20	6	9	36	82.6	16	3.5	270	6	20	6	11	7	90.1	9	1.7	293
6	20	6	9	37	82.8	16	1.7	293	6	20	6	11	8	90.1	9	1.7	293
6	20	6	9	38	82.8	16	3.5	293	6	20	6	11	9	90.1	8	0.9	293
6	20	6	9	39	83.0	16	1.7	315	6	20	6	11	10	90.1	8	1.7	270
6	20	6	9	40	83.0	16	1.7	293	6	20	6	11	11	90.1	9	1.7	293
6	20	6	9	41	83.2	15	1.7	293	6	20	6	11	12	90.1	9	0.9	315
6	20	6	9	42	83.2	16	1.7	293	6	20	6	11	13	90.3	9	3.5	360
6	20	6	9	43	83.2	16	2.6	293	6	20	6	11	14	90.5	9	1.7	293
6	20	6	9	44	83.2	16	1.7	293	6	20	6	11	15	90.7	9	1.7	360
6	20	6	9	45	83.4	16	1.7	293	6	20	6	11	16	90.7	9	3.5	315
6	20	6	9	46	83.4	16	3.5	360	6	20	6	11	17	91.0	9	2.6	293
6	20	6	9	47	83.6	16	0.9	315	6	20	6	11	18	91.2	8	4.3	315
6	20	6	9	48	83.8	17	1.7	360	6	20	6	11	19	91.2	7	4.3	293
6	20	6	9	49	84.0	16	1.7	315	6	20	6	11	20	91.2	8	2.6	293
6	20	6	9	50	84.1	16	0.9	315	6	20	6	11	21	91.2	8	3.5	293
6	20	6	9	51	84.3	16	1.7	315	6	20	6	11	22	91.0	8	5.2	315
6	20	6	9	52	84.7	16	1.7	338	6	20	6	11	23	91.0	8	3.5	293
6	20	6	9	53	84.9	15	3.5	315	6	20	6	11	24	91.0	8	1.7	90
6	20	6	9	54	85.1	15	2.6	293	6	20	6	11	25	91.0	10	1.7	90
6	20	6	9	55	85.1	14	1.7	293	6	20	6	11	26	91.2	8	1.7	315
6	20	6	9	56	85.1	14	1.7	293	6	20	6	11	27	91.2	8	0.9	315
6	20	6	9	57	85.1	15	2.6	293	6	20	6	11	28	91.2	8	1.7	315
6	20	6	9	58	85.1	14	1.7	293	6	20	6	11	29	91.2	9	1.7	293
6	20	6	9	59	85.1	14	1.7	293	6	20	6	11	30	91.2	9	1.7	180
6	20	6	10	0	85.1	14	2.6	293	6	20	6	11	31	91.2	9	1.7	270
6	20	6	10	1	85.3	14	5.2	315	6	20	6	11	32	91.2	8	0.9	293
6	20	6	10	2	85.3	13	5.2	293	6	20	6	11	33	91.0	8	0.9	208
6	20	6	10	3	85.3	14	1.7	293	6	20	6	11	34	91.0	9	1.7	208
6	20	6	10	4	85.3	14	1.7	315	6	20	6	11	35	91.0	8	2.6	338
6	20	6	10	5	85.3	14	1.7	293	6	20	6	11	36	91.2	9	1.7	315
6	20	6	10	6	85.3	13	4.3	293	6	20	6	11	37	91.4	9	2.6	293
6	20	6	10	7	85.3	13	4.3	315	6	20	6	11	38	91.6	9	2.6	293
6	20	6	10	8	85.3	13	2.6	315	6	20	6	11	39	91.6	8	2.6	293
6	20	6	10	9	85.3	12	3.5	293	6	20	6	11	40	91.6	7	4.3	293
6	20	6	10	10	85.3	13	3.5	293	6	20	6	11	41	91.8	7	2.6	360
6	20	6	10	11	85.3	12	4.3	315	6	20	6	11	42	91.8	8	4.3	360
6	20	6	10	12	85.5	13	3.5	293	6	20	6	11	43	92.1	8	2.6	360
6	20	6	10	13	85.5	13	2.6	293	6	20	6	11	44	92.3	9	2.6	360
6	20	6	10	14	85.5	13	4.3	293	6	20	6	11	45	92.5	9	1.7	360
6	20	6	10	15	85.7	13	4.3	293	6	20	6	11	46	92.7	9	2.6	338
6	20	6	10	16	85.7	12	1.7	293	6	20	6	11	47	92.7	8	0.9	360
6	20	6	10	17	85.7	12	2.6	270	6	20	6	11	48	92.9	8	2.6	360
6	20	6	10	18	85.7	13	3.5	315	6	20	6	11	49	93.2	8	3.5	315
6	20	6	10	19	85.7	13	1.7	315	6	20	6	11	50	93.4	10	2.6	315
6	20	6	10	20	85.9	13	1.7	315	6	20	6	11	51	93.4	9	3.5	253
6	20	6	10	21	86.1	14	3.5	315	6	20	6	11	52	93.4	8	1.7	270
6	20	6	10	22	86.1	12	3.5	315	6	20	6	11	53	93.4	8	1.7	23
6	20	6	10	23	86.3	12	0.9	293	6	20	6	11	54	93.6	8	0.9	23
6	20	6	10	24	86.3	12	1.7	338	6	20	6	11	55	93.6	8	3.5	360
6	20	6	10	25	86.3	12	0.9	338	6	20	6	11	56	93.6	7	5.2	360
6	20	6	10	26	86.5	13	2.6	360	6	20	6	11	57	93.8	9	3.5	360
6	20	6	10	27	87.0	13	3.5	315	6	20	6	11	58	93.8	9	3.5	360
6	20	6	10	28	87.2	12	0.9	315	6	20	6	11	59	93.8	7	4.3	23
6	20	6	10	29	87.4	12	0.9	315	6	20	6	12	0	93.8	8	1.7	23
6	20	6	10	30	87.6	10	2.6	270	6	20	6	12	1	94.0	9	1.7	270
6	20	6	10	31	87.6	10	1.7	315	6	20	6	12	2	93.8	7	1.7	293
6	20	6	10	32	87.8	10	1.7	315	6	20	6	12	3	93.6	7	3.5	293
6	20	6	10	33	87.8	10	0.9	293	6	20	6	12	4	93.4	7	1.7	293
6	20	6	10	34	87.8	11	0.9	293	6	20	6	12	5	93.2	8	1.7	293
6	20	6	10	35	88.0	12	2.6	293	6	20	6	12	6	93.2	7	0.9	293
6	20	6	10	36	88.0	12	1.7	315	6	20	6	12	7	93.2	7	2.6	180
6	20	6	10	37	88.2	12	2.6	293	6	20	6	12	8	93.4	8	4.3	315
6	20	6	10	38	88.4	11	3.5	315	6	20	6	12	9	93.4	8	3.5	293
6	20	6	10	39	88.4	10	1.7	270	6	20	6	12	10	93.6	7	3.5	360
6	20	6	10	40	88.4	10	1.7	293	6	20	6	12	11	93.6	6	5.2	360

Backyard weather station data

Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir	Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir
6	21	6	9	20	81.8	22	0.9	208	6	21	6	10	56	91.0	17	2.6	45
6	21	6	9	21	82.0	23	0.9	208	6	21	6	10	57	90.7	15	0.9	45
6	21	6	9	22	82.2	23	0.9	180	6	21	6	10	58	90.7	16	0.9	45
6	21	6	9	23	82.4	22	0.9	180	6	21	6	10	59	91.0	16	0.9	45
6	21	6	9	24	82.6	22	1.7	180	6	21	6	11	0	91.0	17	1.7	360
6	21	6	9	25	82.8	22	1.7	158	6	21	6	11	1	91.2	16	1.7	338
6	21	6	9	26	83.2	22	1.7	180	6	21	6	11	2	91.2	15	0.9	293
6	21	6	9	27	83.6	22	0.9	180	6	21	6	11	3	91.4	15	0.9	293
6	21	6	9	28	83.8	21	0.9	180	6	21	6	11	4	91.4	15	0.9	293
6	21	6	9	29	84.1	21	0.9	180	6	21	6	11	5	91.6	15	0.0	293
6	21	6	9	30	84.3	21	0.9	180	6	21	6	11	6	91.6	15	0.9	293
6	21	6	9	31	84.5	21	0.9	180	6	21	6	11	7	91.6	15	0.9	293
6	21	6	9	32	84.7	21	0.9	180	6	21	6	11	8	91.8	15	0.9	68
6	21	6	9	33	84.7	21	1.7	180	6	21	6	11	9	91.8	14	0.9	68
6	21	6	9	34	84.5	20	1.7	180	6	21	6	11	10	92.1	15	1.7	68
6	21	6	9	35	84.3	20	1.7	180	6	21	6	11	11	91.8	15	2.6	23
6	21	6	9	36	84.1	21	0.9	180	6	21	6	11	12	91.6	15	0.9	45
6	21	6	9	37	84.3	21	0.0	180	6	21	6	11	13	91.6	15	0.9	45
6	21	6	9	38	84.5	21	0.9	180	6	21	6	11	14	91.8	15	0.9	45
6	21	6	9	39	84.7	21	0.9	180	6	21	6	11	15	92.1	15	0.9	45
6	21	6	9	40	84.7	20	0.9	225	6	21	6	11	16	92.1	15	0.9	45
6	21	6	9	41	84.9	21	1.7	315	6	21	6	11	17	92.3	15	2.6	180
6	21	6	9	42	84.9	20	0.9	315	6	21	6	11	18	92.1	15	1.7	225
6	21	6	9	43	85.1	20	0.9	338	6	21	6	11	19	92.1	15	1.7	225
6	21	6	9	44	85.1	21	0.9	338	6	21	6	11	20	91.8	15	0.9	208
6	21	6	9	45	85.3	21	0.0	338	6	21	6	11	21	91.6	15	1.7	208
6	21	6	9	46	85.3	21	0.9	338	6	21	6	11	22	91.4	16	3.5	208
6	21	6	9	47	85.5	22	0.9	338	6	21	6	11	23	91.2	16	3.5	208
6	21	6	9	48	85.7	21	0.9	338	6	21	6	11	24	91.2	16	3.5	208
6	21	6	9	49	85.9	21	0.0	338	6	21	6	11	25	91.2	15	3.5	158
6	21	6	9	50	86.1	21	0.9	338	6	21	6	11	26	91.2	15	3.5	180
6	21	6	9	51	86.3	21	0.9	338	6	21	6	11	27	91.2	15	3.5	180
6	21	6	9	52	86.3	20	0.9	338	6	21	6	11	28	91.2	15	2.6	180
6	21	6	9	53	86.5	20	1.7	360	6	21	6	11	29	91.2	16	0.9	208
6	21	6	9	54	86.5	20	2.6	360	6	21	6	11	30	91.2	15	0.9	208
6	21	6	9	55	86.3	19	2.6	23	6	21	6	11	31	91.4	15	0.9	208
6	21	6	9	56	86.3	19	1.7	23	6	21	6	11	32	91.4	15	0.9	208
6	21	6	9	57	86.3	19	1.7	23	6	21	6	11	33	91.6	15	1.7	208
6	21	6	9	58	86.1	19	0.9	23	6	21	6	11	34	91.6	14	1.7	208
6	21	6	9	59	86.1	19	0.9	23	6	21	6	11	35	91.8	14	1.7	135
6	21	6	10	0	85.9	19	0.9	23	6	21	6	11	36	92.1	14	2.6	180
6	21	6	10	1	85.9	19	0.9	23	6	21	6	11	37	91.8	14	4.3	208
6	21	6	10	2	85.9	20	0.9	23	6	21	6	11	38	91.4	13	3.5	180
6	21	6	10	3	85.7	19	0.9	23	6	21	6	11	39	91.6	13	2.6	158
6	21	6	10	4	85.9	20	0.9	23	6	21	6	11	40	91.6	13	2.6	158
6	21	6	10	5	85.9	20	1.7	360	6	21	6	11	41	91.6	13	1.7	135
6	21	6	10	6	85.9	20	1.7	23	6	21	6	11	42	91.8	13	0.9	135
6	21	6	10	7	86.1	20	0.9	23	6	21	6	11	43	92.1	13	1.7	135
6	21	6	10	8	86.1	21	0.9	23	6	21	6	11	44	92.3	13	0.9	135
6	21	6	10	9	86.3	21	0.9	23	6	21	6	11	45	92.5	13	0.9	113
6	21	6	10	10	86.3	20	1.7	360	6	21	6	11	46	92.5	13	0.9	113
6	21	6	10	11	86.5	20	2.6	360	6	21	6	11	47	92.7	13	0.9	113
6	21	6	10	12	86.5	21	1.7	360	6	21	6	11	48	92.9	13	0.9	113
6	21	6	10	13	86.7	22	0.9	360	6	21	6	11	49	93.2	11	2.6	315
6	21	6	10	14	87.0	22	0.9	360	6	21	6	11	50	93.2	11	1.7	315
6	21	6	10	15	87.2	19	0.9	360	6	21	6	11	51	93.4	11	1.7	315
6	21	6	10	16	87.4	20	1.7	360	6	21	6	11	52	93.6	11	0.9	315
6	21	6	10	17	87.8	20	0.9	360	6	21	6	11	53	93.6	12	1.7	293
6	21	6	10	18	87.8	19	1.7	360	6	21	6	11	54	93.6	12	1.7	293
6	21	6	10	19	87.8	19	1.7	360	6	21	6	11	55	93.6	12	0.9	293
6	21	6	10	20	87.8	18	0.9	45	6	21	6	11	56	93.6	12	0.9	293
6	21	6	10	21	88.0	18	0.9	315	6	21	6	11	57	93.6	12	1.7	293
6	21	6	10	22	88.2	19	0.9	315	6	21	6	11	58	93.6	12	1.7	293
6	21	6	10	23	88.2	19	0.9	315	6	21	6	11	59	93.8	12	0.9	293
6	21	6	10	24	88.2	20	1.7	23	6	21	6	12	0	93.8	12	0.0	293
6	21	6	10	25	88.2	18	1.7	23	6	21	6	12	1	94.0	12	0.9	315
6	21	6	10	26	88.2	19	0.0	23	6	21	6	12	2	94.0	11	0.9	293
6	21	6	10	27	88.4	18	1.7	158	6	21	6	12	3	94.0	11	0.9	293
6	21	6	10	28	88.4	18	0.9	68	6	21	6	12	4	94.0	11	1.7	208
6	21	6	10	29	88.6	19	1.7	68	6	21	6	12	5	93.8	11	1.7	208
6	21	6	10	30	88.4	18	0.9	45	6	21	6	12	6	93.8	11	1.7	293

Backyard weather station data

Month	Date	Year	Hour (PDT)	Minute	Temp (F)	RH%	Kts	Dir
6	22	6	9	30	85.5	23	0.9	208
6	22	6	9	31	85.5	22	1.7	208
6	22	6	9	32	85.5	22	1.7	208
6	22	6	9	33	85.5	23	0.9	208
6	22	6	9	34	85.7	22	0.9	208
6	22	6	9	35	86.1	22	0.9	180
6	22	6	9	36	86.3	22	0.9	180
6	22	6	9	37	86.5	22	0.9	180
6	22	6	9	38	86.5	21	2.6	208
6	22	6	9	39	86.5	22	1.7	208
6	22	6	9	40	86.5	22	0.9	208
6	22	6	9	41	86.7	22	0.0	208
6	22	6	9	42	87.0	22	0.9	208
6	22	6	9	43	87.2	21	0.0	208
6	22	6	9	44	87.2	21	0.0	208
6	22	6	9	45	87.4	21	0.9	208
6	22	6	9	46	87.6	22	0.9	208
6	22	6	9	47	87.8	21	0.9	225
6	22	6	9	48	88.0	21	0.9	225
6	22	6	9	49	88.2	21	0.9	225
6	22	6	9	50	88.2	21	0.9	225
6	22	6	9	51	88.4	21	0.0	225
6	22	6	9	52	88.6	21	0.9	225
6	22	6	9	53	88.6	21	0.9	225
6	22	6	9	54	88.8	21	0.0	225
6	22	6	9	55	89.0	21	0.9	225
6	22	6	9	56	89.0	20	0.9	225
6	22	6	9	57	89.3	20	0.0	225
6	22	6	9	58	89.3	20	0.9	225
6	22	6	9	59	89.5	20	1.7	225
6	22	6	10	0	89.7	21	0.9	225
6	22	6	10	1	89.7	21	0.9	225
6	22	6	10	2	89.9	20	0.9	225
6	22	6	10	3	89.9	19	1.7	225
6	22	6	10	4	89.9	19	1.7	208
6	22	6	10	5	89.9	19	1.7	208
6	22	6	10	6	89.9	19	1.7	208
6	22	6	10	7	89.9	19	2.6	208
6	22	6	10	8	89.7	19	1.7	180
6	22	6	10	9	89.7	19	0.0	180
6	22	6	10	10	89.9	19	1.7	253
6	22	6	10	11	90.1	19	0.9	253
6	22	6	10	12	90.3	19	0.9	253
6	22	6	10	13	90.5	19	0.9	253
6	22	6	10	14	90.7	20	0.9	253
6	22	6	10	15	90.7	19	1.7	253
6	22	6	10	16	91.0	18	0.9	253
6	22	6	10	17	91.0	18	0.9	253
6	22	6	10	18	91.0	19	0.9	253
6	22	6	10	19	90.7	18	0.9	253
6	22	6	10	20	90.5	19	0.9	253
6	22	6	10	21	90.5	19	0.9	253
6	22	6	10	22	90.3	19	0.9	253
6	22	6	10	23	90.3	19	0.0	253
6	22	6	10	24	90.5	19	0.9	253
6	22	6	10	25	90.5	19	0.9	253
6	22	6	10	26	90.5	19	0.9	253
6	22	6	10	27	90.5	19	0.9	253
6	22	6	10	28	90.7	19	0.9	253
6	22	6	10	29	90.7	19	0.0	253
6	22	6	10	30	91.0	18	0.9	225

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2271	21	9.9	230	0.26	320	33	8.204	21000	20274	-15.2	71.4	209	1.9	299	16	0.301
2386	2285	22.8	6	215	0.16	305	23	6.382	21750	20993	-17.1	75	213	2	303	17	0.273
2437	2334	21.3	8	214	0.21	304	23	5.824	22000	21233	-17.4	78.4	211	2.09	301	17	0.266
2500	2394	21.1	10.6	216	0.28	306	24	6.003	22662	21867	-17.5	82	213	2.18	303	16	0.248
2612	2502	20.3	11	222	0.29	312	25	5.953	23000	22189	-18.2	84	217	2.23	307	17	0.249
2965	2843	18.4	10	233	0.27	323	28	5.923	24000	23145	-20.5	92.2	213	2.45	303	18	0.216
3000	2877	18.3	10.6	233	0.28	323	28	5.886	24481	23605	-21.8	92	212	2.45	302	18	0.193
3500	3361	16.9	12.2	234	0.32	324	32	6.159	24975	24078	-23.2	92	210	2.45	300	18	0.17
4000	3846	15.3	12.9	240	0.34	330	37	6.43	25000	24102	-23.2	92.6	210	2.46	300	18	0.17
4304	4142	14.4	15	231	0.4	321	42	6.887	26000	25059	-24.4	96.9	215	2.58	305	18	0.153
4500	4332	14	16.2	230	0.43	320	41	6.551	27000	26013	-25.9	97	215	2.58	305	17	0.126
4620	4449	13.6	16	229	0.43	319	51	7.94	28000	26967	-28	96.7	212	2.57	302	17	0.104
4970	4790	12.6	20	228	0.53	318	53	7.73	28934	27858	-30	101	215	2.69	305	17	0.086
5000	4819	12.5	19.5	229	0.52	319	54	7.824	29000	27921	-29.9	103.2	216	2.75	306	17	0.087
5217	5030	11.9	20	231	0.53	321	47	6.546	29412	28313	-29.2	108	213	2.87	303	17	0.093
5404	5213	11.3	20	228	0.53	318	59	7.898	30000	28870	-30.2	112.2	212	2.98	302	17	0.085
5500	5306	11.1	21.1	227	0.56	317	54	7.133	31000	29817	-32.1	115.7	208	3.08	298	18	0.075
6000	5794	9.6	22.3	230	0.59	320	63	7.529	31289	30090	-32.8	115	209	3.06	299	18	0.07
6194	5984	9.1	23	227	0.61	317	66	7.627	32000	30765	-35	115.4	209	3.07	299	18	0.056
6500	6283	8.5	25.9	229	0.69	319	68	7.545	33000	31717	-37.8	115	208	3.06	298	20	0.047
6585	6366	8.2	26	230	0.69	320	69	7.502	33358	32058	-38.4	115	210	3.06	300	20	0.044
6805	6581	7.8	27	227	0.72	317	69	7.301	34000	32671	-40.2	114.5	211	3.05	301	21	0.039
7000	6772	8	31.6	224	0.84	314	61	6.543	35000	33627	-42.9	114.5	210	3.05	300	22	0.03
7329	7092	8.4	33	222	0.88	312	45	4.96	35415	34024	-43.2	114	209	3.03	299	22	0.029
7500	7258	8	35.2	224	0.94	314	47	5.041	36000	34584	-44.6	117.4	211	3.12	301	23	0.026
7896	7642	8.3	41	215	1.09	305	55	6.021	37000	35542	-47.2	116.1	212	3.09	302	24	0.021
8000	7743	8.2	42.5	213	1.13	303	56	6.089	38000	36501	-48.7	115.1	214	3.06	304	24	0.017
8432	8161	7.5	43	209	1.14	299	59	6.116	39000	37466	-51	113.4	212	3.02	302	25	0.014
8500	8227	7.4	42.9	207	1.14	297	59	6.074	40000	38444	-54	116.2	212	3.09	302	26	0.01
9000	8711	6	42.5	201	1.13	291	61	5.704	40248	38688	-54.6	115	211	3.06	301	26	0.009
9191	8896	5.6	42	200	1.12	290	62	5.639	40503	38940	-55.3	114	211	3.03	301	27	0.009
9500	9195	5.3	42.4	198	1.13	288	48	4.276	41000	39433	-56.1	117.4	212	3.12	302	27	0.008
10000	9679	3.9	40.9	203	1.09	293	40	3.231	42000	40430	-57.9	120.6	216	3.21	306	27	0.007
10235	9907	3.6	42	202	1.12	292	29	2.293	43000	41431	-58	118.4	218	3.15	308	27	0.006
10266	9937	3.6	41	202	1.09	292	27	2.135	44000	42436	-59.3	113.7	219	3.02	309	28	0.006
10438	10103	3.2	43	202	1.14	292	47	3.613	44222	42660	-59.8	110	218	2.93	308	28	0.005
10500	10163	3	43.1	202	1.15	292	50	3.79	45000	43445	-59.1	102.7	218	2.73	308	28	0.006
11000	10648	1.5	42.8	205	1.14	295	57	3.882	45868	44317	-58.5	94	221	2.5	311	27	0.006
11075	10721	1.3	43	206	1.14	296	58	3.894	46000	44450	-58.7	94.1	220	2.5	310	27	0.006
11134	10778	1.1	43	207	1.14	297	58	3.838	46212	44663	-59.1	93	219	2.47	309	28	0.006
11171	10814	1	44	208	1.17	298	58	3.811	47000	45456	-59	85.2	210	2.27	300	27	0.006
11320	10959	1.5	45	209	1.2	299	22	1.498	48000	46465	-60.2	77.5	202	2.06	292	28	0.005
11500	11133	1.6	45.1	208	1.2	298	17	1.166	49000	47479	-60.9	76.5	198	2.03	288	28	0.005
11570	11200	1.8	44	208	1.17	298	14	0.974	49405	47890	-61.8	64	200	1.7	290	28	0.004
11967	11583	1.2	45	208	1.2	298	12	0.8	49923	48412	-57	50	202	1.33	292	27	0.007
12000	11615	1.1	45.7	208	1.22	298	13	0.86	50000	48489	-56.9	50.5	203	1.34	293	27	0.007
12500	12098	0.1	50.2	212	1.34	302	13	0.8	51000	49488	-58.1	50.1	212	1.33	302	27	0.006
12592	12186	-0.1	50	212	1.33	302	15	0.91	52000	50495	-60.2	40.2	221	1.07	311	28	0.005
13000	12580	-1	52.6	208	1.4	298	20	1.136	53000	51510	-62.1	31.2	226	0.83	316	28	0.004
13500	13063	-1.9	53.8	212	1.43	302	19	1.01	54000	52535	-63.7	20.2	201	0.54	291	28	0.003
14000	13545	-3.3	55.3	216	1.47	306	19	0.911	54563	53115	-64.6	20	184	0.53	274	29	0.003
14149	13689	-3.8	56	217	1.49	307	19	0.877	55000	53567	-65.8	23	171	0.61	261	29	0.002
14500	14028	-4.1	61.3	217	1.63	307	17	0.767	55765	54365	-67.7	21	180	0.56	270	29	0.002
15000	14511	-4.6	64	213	1.7	303	16	0.696	55890	54496	-67.9	20	187	0.53	277	29	0.002
16000	15474	-6.5	67.9	213	1.81	303	16	0.602	56000	54611	-66.9	19.3	198	0.51	288	29	0.002
17000	16437	-8.4	67.5	209	1.8	299	16	0.52	56899	55540	-62.8	12	218	0.32	308	28	0.004
17462	16882	-9.6	69	212	1.84	302	19	0.562	57000	55644	-62.6	13.1	222	0.35	312	28	0.004
18000	17400	-10.2	73.1	208	1.94	298	19	0.536	58000	56671	-64.6	11	265	0.29	355	28	0.003
18955	18318	-11	75	205	2	295	16	0.423	59000	57704	-65	5.6	298	0.15	28	28	0.003
19000	18360	-11	75.8	205	2.02	295	16	0.423	59236	57948	-65.5	4	249	0.11	339	28	0.002
19340	18686	-11	75	205	2	295	16	0.423	60000	58738	-64.3	7.3	203	0.19	293	28	0.003
20000	19316	-12.6	72.6	204	1.93	294	16	0.372	60592	59344	-61.7	2	119	0.05	209	28	0.004
									61000	59760	-62.5	10.8	102	0.29	192	28	0.004
									61531	60303	-62.8	13	124	0.35	214	28	0.004

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2406	23.9	13	260	0.35	350	32	9.489	25000	23804	-18.4	75.3	317	2	47	17	0.244
2380	2414	24.2	8	284	0.21	14	15	4.529	25614	24383	-19.9	76	316	2.02	46	22	0.278
2473	2502	22.9	14	280	0.37	10	16	4.466	26000	24748	-20.8	75.7	314	2.01	44	18	0.211
2500	2528	22.6	16	277	0.43	7	17	4.66	27000	25693	-23.6	76.3	313	2.03	43	17	0.155
3000	3007	21.2	15.3	269	0.41	359	21	5.285	27821	26472	-25.9	74	313	1.97	43	17	0.126
3500	3485	19.9	13.5	260	0.36	350	24	5.575	28000	26642	-26.2	74.1	313	1.97	43	17	0.123
3945	3912	18.4	9	253	0.24	343	27	5.712	29000	27593	-28.9	76.1	311	2.02	41	16	0.09
4000	3965	18.4	8.3	254	0.22	344	28	5.923	29253	27834	-29.6	74	310	1.97	40	17	0.09
4500	4446	17.2	7.7	267	0.2	357	28	5.492	30000	28545	-30.3	70.6	313	1.88	43	6	0.03
4858	4789	16.8	9	298	0.24	28	28	5.355	30434	28957	-30.9	70	311	1.86	41	2	0.009
5000	4926	16.3	9.6	301	0.26	31	29	5.372	30963	29459	-31.8	71	311	1.89	41	2	0.009
5500	5406	15	7.5	334	0.2	64	31	5.284	31000	29494	-32	71.2	311	1.89	41	2	0.008
6000	5887	13.6	11.3	330	0.3	60	35	5.449	31620	30083	-33.6	72	311	1.92	41	2	0.007
6419	6291	12.5	13	332	0.35	62	37	5.361	32000	30444	-34.5	68.7	312	1.83	42	2	0.007
6500	6369	12.4	14.5	326	0.39	56	37	5.326	33000	31395	-36.8	70.8	316	1.88	46	2	0.005
7000	6850	11.7	16.2	318	0.43	48	39	5.361	33369	31747	-37.5	70	317	1.86	47	2	0.005
7166	7010	11.4	17	317	0.45	47	40	5.39	34000	32348	-39.1	70.8	318	1.88	48	2	0.004
7471	7303	12.3	23	313	0.61	43	39	5.577	35000	33303	-41.8	71.6	319	1.9	49	2	0.003
7500	7330	12.2	22.9	313	0.61	43	39	5.54	35744	34015	-43.9	72	318	1.92	48	2	0.002
8000	7809	11	24.3	318	0.65	48	38	4.987	36000	34260	-44.6	72.2	317	1.92	47	3	0.003
8500	8288	10	25.2	321	0.67	51	36	4.419	37000	35221	-47.2	74.5	318	1.98	48	5	0.004
8574	8359	9.8	24	322	0.64	52	36	4.361	38000	36185	-50.1	73.3	320	1.95	50	8	0.005
8622	8405	9.7	24	324	0.64	54	36	4.331	39000	37158	-52.9	73	322	1.94	52	11	0.005
9000	8767	9.5	21.9	312	0.58	42	27	3.205	40000	38143	-55.6	67.8	319	1.8	49	13	0.004
9481	9226	9.6	21	301	0.56	31	3	0.359	40147	38289	-56.1	66	317	1.76	47	13	0.004
9500	9244	9.6	22.1	301	0.59	31	3	0.359	40540	38680	-56.6	64	316	1.7	46	14	0.004
9541	9283	9.6	22	300	0.59	30	2	0.239	41000	39139	-57.7	64.8	320	1.72	50	14	0.003
10000	9720	9.2	22.4	314	0.6	44	2	0.233	42000	40143	-59.1	64.2	323	1.71	53	15	0.003
10191	9901	9.4	24	322	0.64	52	2	0.236	43000	41154	-60.7	69.1	323	1.84	53	15	0.003
10210	9919	9.4	24	321	0.64	51	2	0.236	44000	42172	-62.3	72.8	324	1.94	54	16	0.002
10500	10194	9	27.1	314	0.72	44	2	0.23	44937	43134	-63.8	74	327	1.97	57	17	0.002
11000	10668	7.9	26.7	325	0.71	55	2	0.213	45000	43198	-63.8	74.9	327	1.99	57	17	0.002
11500	11142	6.9	32	325	0.85	55	2	0.199	45736	43957	-64.5	76	328	2.02	58	17	0.002
11698	11330	6.4	33	324	0.88	54	2	0.192	46000	44230	-64.2	78.1	324	2.08	54	17	0.002
12000	11616	6.2	33	321	0.88	51	2	0.19	46416	44658	-63.6	79	327	2.1	57	16	0.002
12500	12090	5.5	32.2	330	0.86	60	2	0.181	46850	45103	-62.4	74	331	1.97	61	16	0.002
13000	12562	5	37.5	331	1	61	2	0.174	47000	45257	-62.6	74.5	333	1.98	63	16	0.002
13500	13034	4.6	46.9	328	1.25	58	2	0.17	48000	46284	-64.4	72.2	338	1.92	68	16	0.002
14000	13505	3.7	48.1	319	1.28	49	2	0.159	49000	47319	-65.4	61	339	1.62	69	17	0.002
14500	13976	3.1	49.8	312	1.32	42	2	0.153	50000	48357	-65.8	57.1	326	1.52	56	17	0.001
15000	14445	2.7	53.1	310	1.41	40	2	0.148	50267	48634	-66.1	57	324	1.52	54	17	0.001
15489	14904	2.3	51	307	1.36	37	2	0.144	51000	49397	-66.2	57.2	326	1.52	56	17	0.001
16000	15382	1.4	50.8	312	1.35	42	2	0.135	51747	50172	-64.8	45	331	1.2	61	16	0.002
16911	16235	-0.1	58	317	1.54	47	2	0.121	52000	50434	-65.2	42.6	332	1.13	62	16	0.001
17000	16318	-0.3	59.6	317	1.59	47	2	0.12	53000	51471	-65.8	30.7	331	0.82	61	17	0.001
18000	17252	-1.5	65.6	322	1.74	52	2	0.11	54000	52513	-67.3	22.4	309	0.6	39	17	0.001
19000	18185	-3.8	65.4	320	1.74	50	2	0.092	54557	53097	-68.3	23	300	0.61	30	17	0.001
19131	18307	-4.2	66	321	1.76	51	2	0.09	55000	53563	-68.9	25.4	313	0.68	43	18	0.001
20000	19118	-5.6	75	321	2	51	2	0.081	55560	54155	-69.6	29	317	0.77	47	18	0.001
20617	19694	-7	74	321	1.97	51	2	0.072	56000	54619	-68.4	25.4	332	0.68	62	17	0.001
21000	20051	-7.9	72	321	1.92	51	2	0.068	57000	55665	-66.5	18.9	336	0.5	66	16	0.001
21765	20767	-10.1	71	320	1.89	50	18	0.512	57248	55922	-64.5	14	334	0.37	64	15	0.002
22000	20987	-10.6	72.4	321	1.93	51	18	0.492	58000	56700	-65.8	13.7	334	0.36	64	15	0.001
22713	21655	-12.3	68	320	1.81	50	2	0.048	59000	57741	-66.8	18.9	357	0.5	87	16	0.001
23000	21924	-13	68.9	318	1.83	48	2	0.045	59215	57965	-67.1	16	3	0.43	93	16	0.001
24000	22863	-15.7	72.6	320	1.93	50	5	0.09	60000	58781	-65	14.3	41	0.38	131	15	0.001
24775	23592	-17.7	74	319	1.97	49	14	0.214	60291	59082	-64.9	13	50	0.35	140	15	0.001

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2432	27.3	12	250	0.32	340	25	9.071	24000	22838	-15.8	67.7	315	1.8	45	27	0.483
2383	2443	25.9	11	277	0.29	7	17	5.68	24624	23426	-17.7	69	316	1.84	46	30	0.458
2445	2501	25.2	15	279	0.4	9	19	6.089	24805	23597	-18.1	70	317	1.86	47	31	0.457
2500	2554	24.9	15.8	281	0.42	11	19	5.982	25000	23780	-18.5	71	317	1.89	47	31	0.442
3000	3028	23.4	14.5	282	0.39	12	22	6.33	26000	24726	-21.4	71.3	313	1.9	43	39	0.433
3500	3504	21.9	12.3	297	0.33	27	25	6.567	26135	24853	-21.7	70	313	1.86	43	40	0.433
4000	3980	20.7	11.8	321	0.31	51	27	6.589	27000	25673	-23.5	73.3	311	1.95	41	35	0.323
4500	4457	19.2	15.4	331	0.41	61	29	6.45	28000	26621	-26.1	75.1	308	2	38	36	0.263
4848	4788	18.3	11	335	0.29	65	30	6.307	28678	27265	-27.9	75	312	2	42	34	0.21
5000	4934	17.8	8.3	332	0.22	62	31	6.315	29000	27571	-28.6	75.1	315	2	45	33	0.191
5500	5412	16.3	11.5	2	0.31	92	34	6.299	30000	28523	-30.9	72.4	317	1.93	47	27	0.126
6000	5891	15	9.2	1	0.24	91	36	6.136	31000	29475	-32.7	71.3	315	1.9	45	22	0.086
6433	6306	13.8	8	349	0.21	79	38	5.994	31646	30090	-33.6	70	315	1.86	45	20	0.072
6500	6370	13.7	9	347	0.24	77	38	5.955	32000	30426	-34.6	69.1	316	1.84	46	20	0.065
7000	6849	12.9	16.2	351	0.43	81	38	5.652	33000	31378	-36.5	67.3	318	1.79	48	19	0.051
7323	7159	12.1	15	347	0.4	77	38	5.363	33289	31652	-37.1	66	318	1.76	48	19	0.048
7395	7228	12.2	15	344	0.4	74	38	5.398	34000	32330	-39.2	66.7	317	1.77	47	19	0.039
7500	7329	12.6	15.9	342	0.42	72	35	5.105	35000	33285	-41.8	70.3	314	1.87	44	19	0.029
8000	7806	12.1	19	337	0.51	67	29	4.093	35770	34022	-43.9	71	309	1.89	39	19	0.024
8500	8282	12.6	19.9	314	0.53	44	13	1.896	36000	34243	-44.4	71	311	1.89	41	19	0.022
8504	8286	12.6	19	314	0.51	44	13	1.896	37000	35203	-47.2	70.4	314	1.87	44	20	0.017
8554	8333	12.6	20	313	0.53	43	12	1.75	38000	36167	-50.1	70.2	313	1.87	43	22	0.014
9000	8757	11.2	23	309	0.61	39	12	1.596	39000	37140	-52.7	72.4	318	1.93	48	24	0.011
9500	9232	10.4	24.6	310	0.65	40	11	1.387	39592	37721	-54.4	72	320	1.92	50	25	0.009
10000	9707	9.7	25.6	314	0.68	44	8	0.963	40000	38124	-55.1	70.6	320	1.88	50	25	0.009
10204	9900	9.3	26	323	0.69	53	9	1.054	40563	38683	-56.4	69	323	1.84	53	26	0.008
10500	10181	8.6	25.9	329	0.69	59	9	1.005	41000	39118	-57.5	68.5	324	1.82	54	26	0.007
11000	10656	7.5	29.5	334	0.78	64	10	1.037	41665	39786	-59.2	67	323	1.78	53	27	0.006
11500	11131	6.4	32.4	331	0.86	61	11	1.057	42000	40123	-59.4	66.9	323	1.78	53	27	0.005
12000	11606	5.4	34.1	322	0.91	52	13	1.166	43000	41134	-60.5	72	324	1.92	54	28	0.005
12402	11988	4.3	32	322	0.85	52	14	1.163	44000	42150	-61.5	76.4	328	2.03	58	28	0.004
12500	12081	4.1	33.2	322	0.88	52	14	1.147	45000	43171	-62.6	72	328	1.92	58	29	0.004
13000	12556	3.8	34.9	321	0.93	51	11	0.882	46000	44198	-64	74.5	329	1.98	59	29	0.003
13500	13029	4.2	43.9	326	1.17	56	8	0.66	46458	44669	-63.8	76	331	2.02	61	29	0.003
14000	13500	3.8	46.7	326	1.24	56	7	0.561	47000	45228	-63.9	78.4	331	2.09	61	29	0.003
14284	13768	3.2	47	323	1.25	53	7	0.538	48000	46260	-65	78.1	345	2.08	75	30	0.003
14500	13971	3.4	49.7	319	1.32	49	7	0.546	49000	47298	-66	60.9	340	1.62	70	30	0.002
14569	14036	4	50	318	1.33	48	6	0.488	49199	47505	-66.5	57	340	1.52	70	30	0.002
14624	14087	4.4	51	317	1.36	47	6	0.502	50000	48337	-65.2	50.2	330	1.34	60	30	0.003
15000	14439	4.2	51	321	1.36	51	6	0.495	51000	49374	-65.7	52.6	337	1.4	67	30	0.003
16000	15371	2.7	60.9	323	1.62	53	8	0.594	52000	50416	-67	45.4	331	1.21	61	30	0.002
17000	16302	1.3	59.8	323	1.59	53	7	0.47	53000	51460	-66.9	31.6	332	0.84	62	30	0.002
17074	16371	1.3	60	322	1.6	52	7	0.47	53764	52254	-64.7	23	331	0.61	61	29	0.003
17529	16794	0.9	63	320	1.68	50	9	0.587	54000	52498	-64.9	21.5	322	0.57	52	29	0.003
17968	17201	-0.1	67	318	1.78	48	16	0.971	54577	53096	-66.1	23	313	0.61	43	30	0.002
18000	17231	-0.1	67.5	318	1.8	48	16	0.971	55000	53537	-67.5	26.5	308	0.7	38	31	0.002
19000	18160	-2.8	67.7	316	1.8	46	19	0.945	55459	54019	-68.8	25	307	0.66	37	31	0.002
19163	18311	-3.3	68	316	1.81	46	20	0.959	55823	54403	-69	27	316	0.72	46	31	0.002
19695	18807	-4.9	68	316	1.81	46	25	1.063	56000	54589	-68.5	26.4	325	0.7	55	31	0.002
20000	19091	-5.6	68.7	316	1.83	46	22	0.887	57000	55639	-67.4	22.2	346	0.59	76	30	0.002
21000	20025	-8.2	69.4	318	1.85	48	21	0.693	57053	55694	-67.5	23	344	0.61	74	30	0.002
21576	20564	-9.4	68	319	1.81	49	20	0.601	57717	56383	-64	20	8	0.53	98	28	0.003
22000	20961	-10.7	69.5	316	1.85	46	22	0.596	58000	56675	-64.3	15.5	19	0.41	109	28	0.003
22803	21714	-12.7	68	311	1.81	41	34	0.785	59000	57710	-66.4	10	358	0.27	88	29	0.002
23000	21899	-13.1	68.3	312	1.82	42	31	0.693	60000	58750	-66	8.7	26	0.23	116	29	0.002
23306	22186	-13.9	67	313	1.78	43	24	0.502	60187	58944	-65.8	10	33	0.27	123	29	0.002

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2444	28.5	27	260	0.72	350	25	9.728	29000	27549	-27.6	67.9	316	1.81	46	20	0.127
2381	2453	28.3	14	270	0.37	0	14	5.385	30000	28497	-29.8	68.5	313	1.82	43	16	0.083
2401	2471	27	16	270	0.43	0	15	5.347	31000	29447	-32.5	67.9	313	1.81	43	14	0.056
2434	2502	26.6	19	271	0.51	1	15	5.223	31672	30086	-33.8	65	311	1.73	41	11	0.039
2500	2565	26.1	22.6	271	0.6	1	17	5.747	32000	30398	-34.3	64.8	313	1.72	43	11	0.037
3000	3038	24.4	21.5	276	0.57	6	22	6.722	33000	31349	-36.9	65	313	1.73	43	10	0.026
3500	3511	23.1	21.1	286	0.56	16	24	6.781	33682	32000	-38.9	63	313	1.68	43	10	0.021
4000	3986	21.7	20.1	274	0.53	4	26	6.747	34000	32304	-39.6	64.6	314	1.72	44	10	0.02
4500	4461	20.1	19.7	270	0.52	0	28	6.585	35000	33261	-42.2	66	314	1.76	44	11	0.016
4845	4789	19.1	21	278	0.56	8	30	6.63	35792	34021	-44	67	312	1.78	42	12	0.015
5000	4937	18.8	18.3	282	0.49	12	31	6.724	36000	34220	-44.5	66.7	312	1.77	42	12	0.014
5161	5090	18.3	16	292	0.43	22	32	6.727	37000	35180	-46.7	67.9	315	1.81	45	12	0.011
5500	5413	17.3	17.8	310	0.47	40	34	6.711	38000	36141	-49.2	71	316	1.89	46	14	0.01
5823	5721	16.4	14	322	0.37	52	37	6.898	39000	37109	-51.8	71	319	1.89	49	15	0.008
6000	5890	15.9	12.9	323	0.34	53	37	6.682	40000	38089	-54.2	66.5	321	1.77	51	16	0.006
6500	6368	14.6	18	323	0.48	53	39	6.479	40606	38687	-55.2	66	325	1.76	55	16	0.005
6584	6449	14.3	18	325	0.48	55	40	6.517	41000	39078	-56.2	66.7	326	1.77	56	16	0.005
6789	6645	13.7	17	332	0.45	62	42	6.582	41590	39666	-57.6	69	325	1.84	55	17	0.004
6807	6662	13.6	17	333	0.45	63	42	6.539	42000	40077	-58.4	69.5	326	1.85	56	17	0.004
7000	6847	13.5	16.4	332	0.44	62	40	6.187	43000	41084	-60	71	329	1.89	59	17	0.003
7146	6986	13.1	16	325	0.43	55	40	6.028	44000	42099	-61.3	71.4	332	1.9	62	17	0.003
7348	7179	12.9	13	313	0.35	43	37	5.503	45000	43119	-62.4	68.7	328	1.83	58	18	0.002
7500	7324	13.4	13.1	303	0.35	33	29	4.457	46000	44143	-63.1	71.3	328	1.9	58	18	0.002
7668	7484	14	17	306	0.45	36	17	2.716	46512	44669	-64	72	329	1.92	59	18	0.002
7691	7506	14.1	17	307	0.45	37	17	2.734	47000	45173	-64.5	67.9	331	1.81	61	18	0.002
8000	7800	12.9	16.7	302	0.44	32	18	2.677	48000	46207	-65.2	69.8	343	1.86	73	18	0.002
8500	8276	12.1	16.8	315	0.45	45	13	1.835	49000	47249	-67.5	59.9	346	1.59	76	18	0.001
9000	8751	11	16.8	316	0.45	46	12	1.575	49546	47822	-68.5	56	339	1.49	69	19	0.001
9500	9227	10.1	20.9	322	0.56	52	7	0.865	49625	47905	-68.6	54	338	1.44	68	19	0.001
10000	9702	9.1	20.7	327	0.55	57	6	0.693	50000	48299	-67.5	51.4	336	1.37	66	18	0.001
10210	9902	8.7	21	327	0.56	57	6	0.675	50815	49149	-65.8	57	329	1.52	59	18	0.002
10337	10023	8.4	21	328	0.56	58	6	0.661	51000	49342	-66	57.3	331	1.52	61	18	0.001
10500	10178	8.5	22.3	330	0.59	60	6	0.666	52000	50386	-68	50.2	340	1.34	70	18	0.001
11000	10652	7.6	27	335	0.72	65	5	0.522	52139	50532	-68.3	47	340	1.25	70	18	0.001
11192	10835	7.4	28	337	0.74	67	3	0.309	53000	51434	-66.6	33.1	323	0.88	53	18	0.001
11500	11127	6.9	29.6	330	0.79	60	3	0.298	53873	52341	-65.1	23	341	0.61	71	18	0.002
12000	11601	5.9	32.2	324	0.86	54	5	0.464	54000	52472	-65.1	22.1	345	0.59	75	18	0.002
12500	12075	5	30.1	323	0.8	53	5	0.436	54604	53098	-65.9	11	323	0.29	53	18	0.002
13000	12549	4	34.1	331	0.91	61	5	0.407	55000	53511	-66.7	12.5	306	0.33	36	18	0.001
13154	12695	3.7	34	333	0.9	63	5	0.398	56000	54559	-68.8	17.6	320	0.47	50	18	0.001
13500	13023	3.6	37.2	337	0.99	67	4	0.316	56005	54564	-68.8	17	320	0.45	50	18	0.001
13817	13322	3.6	41	335	1.09	65	2	0.158	56403	54984	-69.4	19	319	0.51	49	18	0.001
14000	13495	3.5	43.9	331	1.17	61	2	0.157	57000	55614	-68.9	23.1	328	0.61	58	18	0.001
14500	13965	3.3	51.2	327	1.36	57	2	0.155	57113	55733	-68.9	24	331	0.64	61	18	0.001
14951	14388	3.9	54	327	1.44	57	2	0.162	57420	56054	-65.6	20	3	0.53	93	18	0.002
15000	14434	3.8	55.3	327	1.47	57	2	0.16	58000	56655	-65.3	17.3	42	0.46	132	17	0.002
16000	15367	2.8	51.6	328	1.37	58	2	0.149	59000	57693	-66.2	13.6	2	0.36	92	17	0.001
16503	15835	2.5	51	332	1.36	62	2	0.146	60000	58733	-66.1	9.4	49	0.25	139	17	0.001
17000	16297	1.6	53.3	330	1.42	60	2	0.137	61000	59775	-67.2	6.2	42	0.16	132	17	0.001
17402	16670	0.8	53	328	1.41	58	2	0.13	61142	59923	-67.6	9	27	0.24	117	17	0.001
17837	17074	-0.1	56	326	1.49	56	9	0.546	61710	60514	-65	14	20	0.37	110	17	0.002
18000	17226	-0.5	57.1	325	1.52	55	12	0.707	62000	60814	-64.5	14.3	27	0.38	117	17	0.002
18905	18067	-2.5	59	320	1.57	50	16	0.814	62121	60938	-64	12	28	0.32	118	17	0.002
19000	18155	-2.7	59.4	319	1.58	49	15	0.752	63000	61840	-63.1	21.5	69	0.57	159	16	0.002
19165	18309	-3.1	59	319	1.57	49	16	0.778	64000	62866	-63.6	11.1	99	0.3	189	16	0.002
20000	19086	-5.1	57.7	321	1.53	51	16	0.67	65000	63890	-62.8	13.7	74	0.36	164	16	0.002
21000	20017	-7.2	62.1	320	1.65	50	13	0.463	66000	64910	-61.6	19.1	54	0.51	144	15	0.002
22000	20950	-9.8	61.5	315	1.64	45	14	0.407	67000	65924	-60.4	17.4	85	0.46	175	15	0.003
23000	21885	-12.5	61.5	313	1.64	43	18	0.422	68000	66936	-60.6	22.4	96	0.6	186	15	0.003
24000	22823	-15.5	61.1	312	1.63	42	22	0.404	68314	67254	-59.1	18	109	0.48	199	14	0.003
24820	23595	-17.7	62	311	1.65	41	27	0.412	68560	67501	-59.2	18	117	0.48	207	14	0.003
25000	23764	-18.2	62.9	311	1.67	41	27	0.395	69000	67945	-59	14.9	129	0.4	219	14	0.003
26000	24708	-21	64.6	314	1.72	44	29	0.333	70000	68953	-59	9.4	110	0.25	200	14	0.003
26322	25012	-21.9	64	312	1.7	42	30	0.319	71000	69961	-58.7	7.1	99	0.19	189	13	0.003
26460	25143	-22.3	64	312	1.7	42	30	0.308	72000	70970	-58.4	13.9	64	0.37	154	13	0.003
27000	25654	-23.2	68.7	314	1.83	44	30	0.284	73000	71979	-58.6	15.3	90	0.41	180	13	0.003
28000	26601	-25.6	72.2	317	1.92	47	26	0.198	74000	72989	-57.9	11	94	0.29	184	12	0.003
									74204	73195	-58.2	11	96	0.29	186	12	0.003

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2280	29.7	6	80	0.16	170	20	8.342	23000	21708	-13.1	19.7	340	0.52	70	8	0.179
2382	2289	28.7	3	63	0.08	153	5	1.968	24000	22648	-15.2	17.8	327	0.47	57	9	0.169
2401	2307	28.3	3	63	0.08	153	5	1.923	25000	23587	-17	17.4	333	0.46	63	8	0.13
2500	2400	27.8	5.1	61	0.14	151	6	2.242	25003	23590	-17	17	333	0.45	63	8	0.13
2610	2504	27.5	7	61	0.19	151	7	2.57	26000	24527	-19.3	15.6	320	0.41	50	8	0.107
3000	2871	26.2	10.3	61	0.27	151	10	3.401	26605	25096	-20.6	16	312	0.43	42	8	0.095
3500	3343	24.7	9.8	36	0.26	126	13	4.044	27000	25468	-21.7	17.4	307	0.46	37	7	0.076
4000	3815	23.3	10.3	45	0.27	135	13	3.718	28000	26411	-24.5	15.5	316	0.41	46	7	0.059
4500	4288	21.7	13.4	53	0.36	143	16	4.152	29000	27358	-27.3	15.7	319	0.42	49	7	0.046
5000	4762	20.2	14.6	51	0.39	141	18	4.259	30000	28306	-29.4	18.2	322	0.48	52	6	0.032
5026	4787	20.2	15	51	0.4	141	17	4.023	31000	29255	-31.8	20.9	323	0.56	53	6	0.026
5500	5237	18.8	14.5	48	0.39	138	18	3.904	31867	30080	-33.9	21	333	0.56	63	6	0.021
5786	5508	18	15	54	0.4	144	19	3.92	32000	30206	-34.3	21.9	332	0.58	62	6	0.02
6000	5712	17.4	14.6	49	0.39	139	21	4.172	33000	31160	-37	17.6	333	0.47	63	7	0.018
6500	6188	16	14.4	47	0.38	137	22	3.998	34000	32115	-39.2	21.4	331	0.57	61	8	0.016
7000	6665	14.5	12.7	27	0.34	117	24	3.961	34301	32403	-40	21	334	0.56	64	8	0.015
7500	7142	12.9	15.3	30	0.41	120	28	4.165	35000	33072	-41.9	24.8	321	0.66	51	9	0.014
8000	7621	11.6	16.2	27	0.43	117	30	4.096	35522	33573	-43.4	27	324	0.72	54	9	0.012
8016	7636	11.5	16	27	0.43	117	31	4.205	35975	34008	-43.6	30	336	0.8	66	9	0.012
8239	7850	10.9	16	17	0.43	107	32	4.171	36000	34031	-43.5	31.1	336	0.83	66	9	0.012
8500	8099	10.8	14.7	8	0.39	98	27	3.496	37000	34987	-44.8	37.1	348	0.99	78	9	0.01
8569	8165	10.5	14	5	0.37	95	27	3.427	38000	35942	-47.3	40.7	347	1.08	77	9	0.008
8708	8298	11.8	13	2	0.35	92	14	1.937	39000	36902	-49.9	42	343	1.12	73	11	0.007
8791	8377	11.8	12	3	0.32	93	11	1.522	40000	37873	-52.2	37.6	333	1	63	12	0.006
9000	8576	11.4	13.9	3	0.37	93	10	1.348	40822	38678	-53.9	34	332	0.9	62	13	0.005
9500	9052	10.3	20.7	13	0.55	103	7	0.877	41000	38853	-54.2	33.5	329	0.89	59	13	0.005
10000	9527	9.3	24.4	14	0.65	104	5	0.586	42000	39841	-55.5	30.4	321	0.81	51	13	0.004
10387	9895	8.9	26	18	0.69	108	5	0.57	43000	40838	-58.3	34.1	323	0.91	53	14	0.003
10500	10003	8.6	26.3	20	0.7	110	4	0.447	43314	41153	-59.2	36	320	0.96	50	15	0.003
10691	10184	8.3	25	21	0.66	111	4	0.438	44000	41845	-59.7	40.8	314	1.09	44	15	0.003
11000	10478	7.9	26.2	17	0.7	107	4	0.426	45000	42858	-60.8	39.3	314	1.05	44	15	0.002
11282	10745	7.9	27	13	0.72	103	4	0.426	46000	43877	-62.8	37.6	320	1	50	16	0.002
11500	10952	7.8	28.3	9	0.75	99	16	1.693	46759	44658	-64.3	36	323	0.96	53	16	0.002
11786	11223	7	28	8	0.74	98	26	2.605	47000	44907	-64.8	36.8	324	0.98	54	16	0.002
12000	11425	7.4	26.9	7	0.72	97	22	2.265	48000	45945	-66.7	28.8	336	0.77	66	17	0.001
12500	11897	6.3	27.9	5	0.74	95	18	1.718	49000	46991	-67.5	19	316	0.51	46	17	0.001
13000	12369	5.5	28.5	5	0.76	95	19	1.716	50000	48043	-69.4	25.4	296	0.68	26	17	0.001
13231	12588	4.9	29	6	0.77	96	20	1.733	51000	49104	-70.7	24.6	306	0.65	36	18	0.001
13500	12841	5.3	25.7	7	0.68	97	12	1.069	52000	50174	-72.9	18	316	0.48	46	18	0.001
14000	13311	5.4	29.1	19	0.77	109	4	0.359	53000	51252	-74.1	12.7	351	0.34	81	18	0
14126	13429	5.3	31	16	0.82	106	2	0.178	53321	51600	-74.8	10	350	0.27	80	18	0
14500	13779	5.5	33.5	3	0.89	93	2	0.181	53458	51749	-74.9	10	346	0.27	76	18	0
14566	13841	5.7	32	3	0.85	93	2	0.183	54000	52337	-74.3	16	329	0.43	59	18	0
15000	14245	5	30	353	0.8	83	3	0.262	54389	52759	-74.9	20	339	0.53	69	18	0
16000	15176	3.9	29.6	337	0.79	67	3	0.242	54709	53105	-73.6	21	351	0.56	81	18	0
16084	15254	3.9	28	335	0.74	65	2	0.162	55000	53417	-71.2	14.5	330	0.39	60	18	0.001
17000	16105	1.7	25.2	336	0.67	66	4	0.276	55357	53794	-67.5	14	342	0.37	72	17	0.001
17806	16855	-0.1	20	326	0.53	56	4	0.243	55957	54419	-65.6	7	109	0.19	199	16	0.001
18000	17036	-0.5	23	331	0.61	61	4	0.236	56000	54464	-65.7	7.9	124	0.21	214	17	0.001
19000	17966	-2.7	24.2	331	0.64	61	4	0.201	57000	55507	-67.8	8.5	159	0.23	249	17	0.001
19362	18304	-3.6	25	334	0.66	64	5	0.234	57123	55636	-68	7	172	0.19	262	17	0.001
20000	18899	-5.2	24	330	0.64	60	5	0.208	58000	56553	-66.4	9.1	83	0.24	173	16	0.001
20970	19805	-7.9	20	339	0.53	69	7	0.236	59000	57597	-67.8	10.9	92	0.29	182	16	0.001
21000	19833	-7.9	20.8	339	0.55	69	7	0.236	60000	58645	-67.8	4.5	126	0.12	216	16	0.001
22000	20769	-10.4	23.2	340	0.62	70	8	0.222	60285	58944	-67.1	3	83	0.08	173	16	0.001

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2315	27.4	12	220	0.32	310	20	7.299	25466	24105	-21.6	14	323	0.37	53	12	0.131
2379	2322	29.3	6	230	0.16	320	2	0.815	26000	24613	-22.7	9.9	319	0.26	49	12	0.119
2433	2372	27.3	7	228	0.19	318	3	1.088	27000	25567	-25.4	8.3	319	0.22	49	11	0.086
2500	2436	27	9.5	227	0.25	317	4	1.426	27344	25896	-26.5	10	316	0.27	46	10	0.07
2572	2503	26.4	11	227	0.29	317	5	1.721	28000	26523	-27.1	9.7	328	0.26	58	10	0.067
3000	2908	25	13.5	233	0.36	323	8	2.534	28222	26734	-27.3	9	332	0.24	62	10	0.065
3042	2948	24.7	13	233	0.35	323	8	2.489	29000	27477	-29.6	8.3	256	0.22	346	9	0.047
3500	3381	23.6	10.8	245	0.29	335	11	3.203	30000	28433	-31.8	9	340	0.24	70	8	0.034
3658	3531	23.1	11	245	0.29	335	12	3.391	31000	29391	-34.2	11.2	345	0.3	75	7	0.024
4000	3855	23	15.1	250	0.4	340	5	1.404	31708	30070	-35.9	10	337	0.27	67	7	0.02
4500	4328	21.8	9.5	262	0.25	352	4	1.044	32000	30350	-36.7	10.7	339	0.28	69	7	0.018
4821	4632	21	8	252	0.21	342	5	1.243	33000	31311	-38.9	12	334	0.32	64	7	0.015
4983	4785	21.1	8	240	0.21	330	3	0.75	33312	31611	-39.9	12	337	0.32	67	7	0.013
5000	4802	21.1	8.1	239	0.22	329	3	0.75	34000	32274	-41.5	13.7	336	0.36	66	7	0.011
5150	4943	21.1	8	239	0.21	329	2	0.5	34205	32472	-42.2	13	338	0.35	68	7	0.01
5420	5198	21.2	7	246	0.19	336	2	0.503	35000	33238	-43.2	11.2	340	0.3	70	7	0.009
5500	5273	21	6.9	248	0.18	338	2	0.497	35797	34007	-45.4	14	345	0.37	75	7	0.007
6000	5745	20	7.5	261	0.2	351	2	0.467	36000	34202	-46	13.6	345	0.36	75	7	0.007
6500	6216	19.3	12.3	241	0.33	331	2	0.448	37000	35168	-47.9	14.5	351	0.39	81	7	0.006
7000	6687	18.6	9.6	223	0.26	313	2	0.428	38000	36132	-49.3	10.4	39	0.28	129	8	0.005
7500	7157	17.6	7.5	224	0.2	314	2	0.402	39000	37100	-51.4	6.9	42	0.18	132	9	0.005
8000	7627	16.3	11.1	223	0.3	313	2	0.371	40000	38076	-53	15.6	289	0.41	19	10	0.004
8500	8098	15.1	12	222	0.32	312	2	0.343	40019	38095	-53.1	16	288	0.43	18	10	0.004
9000	8570	13.9	12.7	238	0.34	328	2	0.318	40606	38670	-53.2	24	284	0.64	14	10	0.004
9500	9041	12.8	13.7	241	0.36	331	2	0.296	41000	39056	-53.2	24.4	285	0.65	15	10	0.004
10000	9513	11.6	14.3	235	0.38	325	2	0.273	42000	40039	-54.6	20.9	310	0.56	40	10	0.004
10126	9632	11.2	16	231	0.43	321	2	0.266	43000	41029	-56.2	17.4	307	0.46	37	11	0.003
10395	9886	11.1	16	224	0.43	314	2	0.264	44000	42026	-57.5	17.3	261	0.46	351	12	0.003
10500	9985	10.8	14	222	0.37	312	2	0.259	45000	43029	-58.9	24.3	267	0.65	357	12	0.003
11000	10457	10	10.6	221	0.28	311	2	0.246	45115	43144	-59.3	26	267	0.69	357	12	0.002
11500	10928	9.4	12.1	245	0.32	335	3	0.354	45779	43812	-58.1	36	286	0.96	16	12	0.003
12000	11399	8	12.8	215	0.34	305	4	0.429	46000	44033	-57.8	30.6	281	0.81	11	12	0.003
12500	11870	6.7	12.9	215	0.34	305	5	0.491	46616	44651	-58.8	26	280	0.69	10	12	0.003
13000	12342	6	19.5	226	0.52	316	4	0.374	47000	45038	-59.7	21.7	274	0.58	4	12	0.002
13500	12813	4.9	21.5	219	0.57	309	5	0.433	48000	46052	-61.9	13.4	242	0.36	332	13	0.002
13979	13264	4.5	18	214	0.48	304	4	0.337	49000	47077	-64.1	14	187	0.37	277	14	0.002
14000	13284	4.4	18.4	213	0.49	303	4	0.335	49797	47902	-66	22	291	0.59	21	15	0.001
14500	13755	3.2	20.1	216	0.53	306	4	0.308	49938	48049	-66.2	21	293	0.56	23	15	0.001
15000	14226	1.9	18.9	218	0.5	308	5	0.35	50000	48114	-66.2	21.1	295	0.56	25	15	0.001
16000	15168	0.3	18.8	222	0.5	312	5	0.312	51000	49153	-65.8	27.5	310	0.73	40	14	0.001
16097	15259	-0.1	19	224	0.51	314	6	0.364	52000	50193	-66.3	12.7	262	0.34	352	15	0.001
17000	16110	-1.8	20.3	237	0.54	327	11	0.589	53000	51236	-67	12.6	273	0.34	3	15	0.001
18000	17051	-3.4	24.8	240	0.66	330	10	0.476	54000	52279	-66.4	8.6	263	0.23	353	14	0.001
19000	17992	-5.6	22.7	234	0.6	324	10	0.403	54790	53102	-66.5	7	294	0.19	24	15	0.001
19321	18294	-6.1	24	239	0.64	329	10	0.388	55000	53321	-66.2	7.1	307	0.19	37	14	0.001
20000	18933	-7.8	22.6	243	0.6	333	10	0.34	56000	54363	-67	4	275	0.11	5	15	0.001
20695	19588	-9.1	15	268	0.4	358	10	0.308	56799	55199	-67.6	3	217	0.08	307	15	0.001
21000	19875	-9.9	16.4	281	0.44	11	10	0.289	57000	55410	-67.4	3.6	249	0.1	339	15	0.001
22000	20818	-12.5	11.3	291	0.3	21	11	0.258	58000	56453	-66.2	4.3	224	0.11	314	14	0.001
23000	21764	-15.2	11.8	320	0.31	50	11	0.207	59000	57490	-65.2	4.4	276	0.12	6	14	0.001
24000	22712	-17.7	9.8	306	0.26	36	12	0.183	60000	58520	-63.3	11.7	39	0.31	129	13	0.002
24916	23581	-19.9	23	299	0.61	29	12	0.152	61000	59543	-62.2	9.4	72	0.25	162	12	0.002
25000	23661	-20.1	22.2	308	0.59	38	12	0.149	61893	60452	-61.2	12	46	0.32	136	12	0.002

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2324	31.3	8.9	220	0.24	310	12	5.485	28000	26523	-27.5	12.9	331	0.34	61	6	0.038
2393	2343	31	6	243	0.16	333	2	0.899	29000	27479	-29.8	12	343	0.32	73	6	0.031
2444	2391	29.8	7	241	0.19	331	2	0.839	30000	28436	-31.8	14.3	16	0.38	106	6	0.026
2500	2443	29.6	9.2	241	0.24	331	2	0.829	31000	29394	-34.5	14.5	12	0.39	102	6	0.02
2564	2503	29.3	10	241	0.27	331	2	0.815	31701	30068	-36.4	15	12	0.4	102	7	0.019
3000	2911	28	9	248	0.24	338	2	0.756	32000	30355	-37	11.7	3	0.31	93	7	0.018
3500	3380	26.7	11	253	0.29	343	2	0.701	32405	30745	-38.2	9	1	0.24	91	8	0.018
4000	3849	25.4	10.6	240	0.28	330	2	0.649	33000	31318	-39.4	11.8	2	0.31	92	9	0.018
4500	4318	24.1	9.8	248	0.26	338	2	0.6	34000	32282	-41.7	12.5	353	0.33	83	11	0.017
4996	4784	22.5	8	253	0.21	343	2	0.545	35000	33247	-44	13.5	1	0.36	91	13	0.016
5000	4788	22.5	8.4	253	0.22	343	2	0.545	35780	34001	-45.4	17	9	0.45	99	14	0.015
5471	5232	21.2	7	268	0.19	358	3	0.755	36000	34213	-45.8	16.1	9	0.43	99	15	0.015
5500	5259	21.2	8.1	267	0.22	357	3	0.755	37000	35178	-47.8	12.4	29	0.33	119	16	0.013
6000	5730	20.4	11.4	248	0.3	338	2	0.479	38000	36142	-49.4	9.8	20	0.26	110	17	0.011
6500	6201	19.2	11.3	249	0.3	339	2	0.445	39000	37111	-51.6	4.1	296	0.11	26	19	0.01
7000	6672	17.9	12.3	244	0.33	334	2	0.41	40000	38087	-53.2	20.1	282	0.53	12	20	0.009
7500	7144	16.8	13.1	231	0.35	321	2	0.382	40590	38665	-52.9	23	292	0.61	22	20	0.009
8000	7615	15.9	14.9	225	0.4	315	2	0.361	40651	38725	-52.7	22	294	0.59	24	19	0.009
8500	8087	14.7	15.5	228	0.41	318	2	0.334	41000	39067	-53.7	21.9	300	0.58	30	20	0.008
9000	8559	13.9	15.6	234	0.41	324	2	0.318	42000	40056	-56.5	25.9	303	0.69	33	21	0.006
9500	9030	12.9	17	232	0.45	322	2	0.297	42120	40175	-56.7	27	305	0.72	35	22	0.006
10000	9502	12.3	12	209	0.32	299	2	0.286	43000	41050	-55.9	14.3	297	0.38	27	21	0.006
10409	9887	11.6	9	210	0.24	300	2	0.273	43240	41288	-55.6	12	283	0.32	13	21	0.007
10500	9972	11.4	8.4	207	0.22	297	2	0.27	44000	42045	-57.8	12.4	259	0.33	349	22	0.005
11000	10443	10.1	12.5	224	0.33	314	2	0.247	45000	43049	-59.1	21.5	279	0.57	9	22	0.005
11500	10914	9	11	229	0.29	319	2	0.23	46000	44060	-61.2	21.4	299	0.57	29	23	0.004
12000	11386	7.7	13.3	216	0.35	306	2	0.21	46069	44131	-61.4	22	299	0.59	29	23	0.004
12500	11858	6.9	16.7	232	0.44	322	2	0.199	46581	44650	-60.2	21	288	0.56	18	23	0.004
13000	12329	5.9	21.8	228	0.58	318	2	0.186	46744	44815	-60.4	20	285	0.53	15	23	0.004
13500	12801	4.7	24.4	221	0.65	311	4	0.342	47000	45075	-61	20.8	278	0.55	8	23	0.004
13816	13099	3.8	23	222	0.61	312	3	0.241	48000	46097	-63.6	21.5	277	0.57	7	24	0.003
14000	13273	3.7	22.7	219	0.6	309	2	0.159	48563	46678	-65.3	17	278	0.45	8	25	0.002
14500	13744	3.3	19.3	213	0.51	303	2	0.155	49000	47131	-65.2	15.3	273	0.41	3	25	0.002
14595	13834	3.3	18	214	0.48	304	2	0.155	49772	47934	-67.2	19	282	0.51	12	25	0.002
15000	14215	2.1	20.2	225	0.54	315	2	0.142	50000	48173	-66.7	21.5	294	0.57	24	25	0.002
16000	15157	0.2	18.4	223	0.49	313	2	0.124	51000	49213	-65.4	10.4	289	0.28	19	25	0.002
16136	15285	-0.1	17	223	0.45	313	2	0.121	52000	50254	-67.1	13.7	278	0.36	8	25	0.002
17000	16099	-1.9	17.2	248	0.46	338	5	0.266	53000	51299	-67.2	13.8	252	0.37	342	25	0.002
18000	17041	-3.6	19.9	250	0.53	340	4	0.187	53341	51656	-67.7	16	260	0.43	350	25	0.002
18257	17283	-3.9	17	251	0.45	341	3	0.137	54000	52346	-67.4	13.4	306	0.36	36	25	0.002
19000	17982	-5.8	17.2	258	0.46	348	4	0.159	54712	53092	-67.6	7	272	0.19	2	25	0.002
19330	18293	-6.5	14	258	0.37	348	4	0.15	55000	53393	-67.2	6.7	291	0.18	21	25	0.002
20000	18925	-8.3	15.1	265	0.4	355	4	0.131	56000	54438	-67.1	2.3	26	0.06	116	25	0.002
21000	19869	-10.8	11.6	300	0.31	30	4	0.108	57000	55485	-67.9	6.2	21	0.16	111	25	0.002
21781	20609	-13	8	286	0.21	16	5	0.113	58000	56533	-67.5	4.6	58	0.12	148	25	0.002
22000	20816	-13.4	6.1	303	0.16	33	5	0.109	58259	56804	-68	2	354	0.05	84	25	0.002
23000	21764	-15.4	7.7	310	0.2	40	7	0.13	59000	57579	-66.5	10.6	315	0.28	45	24	0.002
24000	22712	-17.8	9.8	323	0.26	53	7	0.106	60000	58615	-64.4	15.4	54	0.41	144	23	0.002
24911	23578	-20.2	10	320	0.27	50	8	0.099	61000	59646	-64.3	17.3	112	0.46	202	23	0.002
25000	23663	-20.5	9.8	317	0.26	47	8	0.096	61839	60509	-63.7	10	128	0.27	218	23	0.003
26000	24615	-22.9	10.5	309	0.28	39	7	0.068	62000	60674	-63.5	9.8	108	0.26	198	23	0.003
27000	25569	-25	11	326	0.29	56	7	0.056	62121	60798	-63.1	10	93	0.27	183	23	0.003

Atmospheric Profile Data: LBNB-06/21/06-16:20 Z-v1

ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2306	24.8	2.9	150	0.08	240	30	9.388	24939	23579	-20.8	28	278	0.74	8	4	0.047
2377	2311	26.1	3	187	0.08	277	2	0.676	25000	23638	-21	28.2	277	0.75	7	4	0.046
2500	2428	25.1	4.4	186	0.12	276	4	1.274	25062	23697	-21.3	28	276	0.74	6	4	0.045
2578	2502	24.8	4	174	0.11	264	6	1.878	26000	24594	-24	28.9	278	0.77	8	5	0.044
3000	2903	23.7	2.9	191	0.08	281	12	3.516	27000	25550	-25.4	24.1	298	0.64	28	2	0.016
3067	2966	23.4	3	197	0.08	287	13	3.74	28000	26506	-27.6	24.2	306	0.64	36	2	0.013
3164	3058	23.5	4	207	0.11	297	15	4.342	29000	27462	-29.5	24.6	298	0.65	28	2	0.011
3500	3377	23.6	4.8	261	0.13	351	14	4.077	30000	28418	-31.6	28.5	303	0.76	33	2	0.009
4000	3851	22.6	5.9	339	0.16	69	14	3.838	31000	29375	-33.7	28.7	306	0.76	36	2	0.007
4500	4324	21.9	3.4	322	0.09	52	15	3.94	31728	30072	-35.4	28	305	0.74	35	2	0.006
4990	4788	21.1	3	23	0.08	113	14	3.502	32000	30332	-36.2	27.6	304	0.73	34	2	0.006
5000	4797	21.1	3.2	21	0.09	111	14	3.502	33000	31292	-38.8	27.9	305	0.74	35	3	0.006
5374	5151	20.6	3	30	0.08	120	15	3.638	33514	31786	-40	28	308	0.74	38	3	0.006
5500	5270	20.4	4.3	59	0.11	149	14	3.354	34000	32253	-41.1	25.4	298	0.68	28	4	0.007
5551	5318	20.3	4	63	0.11	153	14	3.333	35000	33217	-43.5	27.5	302	0.73	32	5	0.006
5696	5455	20.5	5	58	0.13	148	2	0.482	35433	33634	-44.6	28	304	0.74	34	6	0.007
6000	5741	20.1	5.2	25	0.14	115	2	0.47	35821	34008	-44.9	26	308	0.69	38	6	0.007
6472	6185	20.7	3	88	0.08	178	2	0.488	36000	34181	-45	26.5	306	0.7	36	6	0.007
6500	6211	20.6	3.9	93	0.1	183	2	0.485	37000	35142	-46.8	27.5	299	0.73	29	7	0.006
7000	6680	19.4	5.9	96	0.16	186	2	0.45	38000	36103	-48.6	25.9	291	0.69	21	8	0.006
7500	7149	18.3	4.8	96	0.13	186	2	0.42	39000	37067	-50.6	34.7	295	0.92	25	9	0.005
8000	7619	17	6.1	65	0.16	155	2	0.387	40000	38039	-52	29.8	294	0.79	24	10	0.005
8500	8089	15.5	7.1	73	0.19	163	2	0.352	40642	38666	-52.4	26	283	0.69	13	10	0.005
8560	8145	15.3	7	78	0.19	168	2	0.348	41000	39016	-52.6	26.9	288	0.72	18	10	0.005
9000	8559	14.6	6.7	83	0.18	173	2	0.332	42000	39996	-53.7	34.3	293	0.91	23	11	0.004
9500	9029	14.2	4.3	127	0.11	217	2	0.324	43000	40983	-55.9	33.5	291	0.89	21	12	0.004
10000	9499	13.2	4.7	85	0.13	175	2	0.303	44000	41977	-57	29.2	295	0.78	25	12	0.003
10416	9889	12.2	7	83	0.19	173	2	0.284	45000	42979	-58.8	26.7	290	0.71	20	13	0.003
10500	9968	11.9	7.3	81	0.19	171	2	0.279	46000	43988	-60.4	24.4	287	0.65	17	14	0.002
11000	10438	10.9	8.5	101	0.23	191	2	0.261	46651	44648	-60.9	20	290	0.53	20	14	0.002
11500	10908	9.8	8.1	99	0.22	189	2	0.242	47000	45003	-61.5	21.1	289	0.56	19	14	0.002
12000	11378	9	10.4	70	0.28	160	2	0.23	48000	46025	-63.3	22.8	277	0.61	7	15	0.002
12500	11847	8.3	7.9	94	0.21	184	2	0.219	49000	47055	-64.6	22	300	0.59	30	15	0.002
13000	12317	7.1	4.8	62	0.13	152	2	0.202	50000	48092	-66.4	18	291	0.48	21	16	0.001
13500	12786	6.5	2.3	89	0.06	179	2	0.194	51000	49137	-67.4	15.2	286	0.4	16	16	0.001
14000	13254	5.7	8.7	5	0.23	95	2	0.183	52000	50186	-68.1	11.6	287	0.31	17	17	0.001
14500	13723	4.6	13.9	354	0.37	84	2	0.17	53000	51241	-70.3	18.2	312	0.48	42	17	0.001
14695	13906	4.7	12	6	0.32	96	2	0.171	53402	51669	-71.2	19	318	0.51	48	17	0.001
15000	14191	4	13.7	11	0.36	101	2	0.163	53473	51745	-71.3	18	321	0.48	51	17	0.001
16000	15128	1.6	11.6	1	0.31	91	2	0.137	54000	52305	-69.6	6.2	324	0.16	54	17	0.001
16576	15668	-0.1	13	7	0.35	97	2	0.121	54732	53080	-69.8	10	325	0.27	55	17	0.001
17000	16067	-1.1	14.8	356	0.39	86	2	0.113	55000	53363	-69.7	13.8	336	0.37	66	17	0.001
18000	17007	-3.7	15.6	356	0.41	86	2	0.093	56000	54419	-68.8	8.9	40	0.24	130	17	0.001
19000	17950	-6	19.4	353	0.52	83	2	0.078	57000	55472	-68.4	11.5	44	0.31	134	16	0.001
19366	18295	-6.9	17	340	0.45	70	2	0.073	58000	56521	-67.7	2.2	276	0.06	6	16	0.001
20000	18893	-8.3	17.5	337	0.47	67	2	0.065	58934	57499	-67.5	5	261	0.13	351	16	0.001
21000	19838	-10.9	13.5	303	0.36	33	2	0.053	59000	57568	-67.3	5.2	273	0.14	3	16	0.001
22000	20786	-13.7	16.2	304	0.43	34	2	0.043	60000	58609	-65.3	13.4	49	0.36	139	15	0.001
23000	21735	-15.8	21.9	284	0.58	14	2	0.036	61000	59643	-64.8	3.6	97	0.1	187	14	0.001
24000	22685	-18.4	22.5	274	0.6	4	2	0.029	61252	59902	-62.9	6	75	0.16	165	14	0.002

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum	ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2309	30.4	4.1	110	0.11	200	23	9.987	26000	24572	-22.8	20.5	303	0.55	33	8	0.079
2403	2338	30.2	3	113	0.08	203	2	0.859	27000	25525	-24.9	21.6	306	0.57	36	8	0.065
2491	2421	29	4	121	0.11	211	2	0.801	28000	26479	-27.1	20.3	309	0.54	39	7	0.047
2500	2429	29	4.7	121	0.13	211	2	0.801	29000	27433	-28.8	22.6	320	0.6	50	6	0.034
2580	2504	28.8	5	124	0.13	214	3	1.188	30000	28387	-31.2	23.7	320	0.63	50	5	0.023
3000	2898	27.7	2	101	0.05	191	6	2.228	31000	29343	-33.7	22.5	317	0.6	47	5	0.018
3500	3367	26.2	1.9	89	0.05	179	9	3.061	31758	30069	-35.6	21	314	0.56	44	4	0.012
4000	3836	25	2.8	225	0.07	315	8	2.534	32000	30301	-36.2	21.5	314	0.57	44	4	0.011
4297	4116	24.1	2	260	0.05	350	9	2.701	33000	31261	-38.8	23.1	311	0.61	41	4	0.009
4500	4307	23.8	2.1	271	0.06	1	7	2.063	33289	31539	-39.7	23	312	0.61	42	4	0.008
5000	4776	23	1.9	289	0.05	19	2	0.562	34000	32223	-41	26.8	314	0.71	44	5	0.008
5009	4785	23	2	289	0.05	19	2	0.562	35000	33186	-43	22.8	308	0.61	38	5	0.007
5500	5246	22.3	5	133	0.13	223	2	0.538	35852	34005	-44.4	26	303	0.69	33	5	0.006
5678	5413	22.4	8	119	0.21	209	2	0.542	36000	34147	-44.7	24.6	303	0.65	33	5	0.006
6000	5715	21.5	5.9	121	0.16	211	2	0.513	37000	35107	-46.4	22.4	297	0.6	27	5	0.005
6500	6184	20.2	6.7	123	0.18	213	2	0.473	38000	36067	-48.2	26.9	295	0.72	25	5	0.004
7000	6654	19.2	5.6	116	0.15	206	2	0.445	39000	37029	-49.9	28.5	303	0.76	33	6	0.004
7500	7123	18.3	11.5	101	0.31	191	2	0.42	40000	37997	-51.1	24.7	281	0.66	11	7	0.004
8000	7592	17.4	13.6	85	0.36	175	2	0.397	40687	38666	-52.2	28	277	0.74	7	7	0.003
8500	8061	16.7	13.8	77	0.37	167	2	0.38	41000	38972	-52.6	27.7	283	0.74	13	8	0.004
9000	8530	15.3	12.9	67	0.34	157	2	0.348	42000	39953	-54.1	35.1	290	0.93	20	8	0.003
9500	9000	14	10.8	84	0.29	174	2	0.32	43000	40940	-55.4	34.7	290	0.92	20	9	0.003
10000	9470	12.6	11.5	94	0.31	184	2	0.292	44000	41933	-57.1	31.3	291	0.83	21	10	0.003
10193	9652	12	11	91	0.29	181	2	0.28	45000	42934	-58.4	26.7	288	0.71	18	10	0.002
10445	9889	11.5	11	88	0.29	178	2	0.271	46000	43942	-60.2	26.2	281	0.7	11	11	0.002
10500	9941	11.5	10.9	90	0.29	180	2	0.271	46694	44646	-61.5	25	285	0.66	15	12	0.002
11000	10411	10.7	6.9	65	0.18	155	2	0.257	47000	44958	-62	24	285	0.64	15	12	0.002
11500	10881	9.9	7	41	0.19	131	2	0.244	47695	45670	-63.8	28	293	0.74	23	12	0.001
12000	11351	8.8	12.5	61	0.33	151	2	0.226	48000	45984	-64.2	27.3	296	0.73	26	13	0.001
12500	11821	8.4	8	91	0.21	181	2	0.22	49000	47019	-65.5	26	292	0.69	22	13	0.001
13000	12290	7.5	3.8	72	0.1	162	2	0.207	50000	48057	-65.9	19.3	296	0.51	26	13	0.001
13500	12759	6.6	2.8	295	0.07	25	2	0.195	51000	49102	-68	20.1	303	0.53	33	14	0.001
14000	13228	5.5	6.7	9	0.18	99	2	0.181	52000	50154	-69	11.5	297	0.31	27	14	0.001
14500	13696	4.9	7.2	25	0.19	115	5	0.433	53000	51213	-70.3	12.3	313	0.33	43	15	0.001
14547	13740	4.9	7	26	0.19	116	5	0.433	53151	51373	-70.7	12	319	0.32	49	15	0.001
15000	14165	3.9	13	35	0.35	125	5	0.404	53293	51524	-70.9	14	333	0.37	63	15	0.001
16000	15102	1.5	13.5	25	0.36	115	6	0.409	54000	52273	-69	8.5	330	0.23	60	14	0.001
16646	15708	-0.1	18	12	0.48	102	6	0.364	54785	53099	-67.9	9	7	0.24	97	14	0.001
17000	16041	-1.1	15.5	12	0.41	102	6	0.338	55000	53324	-67.7	7.1	40	0.19	130	14	0.001
18000	16980	-3.1	13.7	7	0.36	97	7	0.341	55398	53740	-66	5	105	0.13	195	13	0.001
19000	17922	-6	16.9	360	0.45	90	9	0.352	56000	54367	-67.1	6.1	149	0.16	239	13	0.001
19394	18293	-7.3	17	358	0.45	88	10	0.354	57000	55408	-65.6	3.8	68	0.1	158	13	0.001
20000	18867	-8.9	14.1	1	0.38	91	10	0.312	58000	56445	-65.6	5.6	293	0.15	23	13	0.001
21000	19814	-11.3	16.2	330	0.43	60	10	0.258	59000	57482	-65.4	4.3	30	0.11	120	12	0.001
22000	20763	-13.9	19.5	307	0.52	37	10	0.209	60000	58517	-65	16.6	89	0.44	179	12	0.001
22425	21167	-15.2	16	297	0.43	27	10	0.188	61000	59552	-65.6	18.5	139	0.49	229	12	0.001
23000	21714	-16.3	21	283	0.56	13	10	0.172	61681	60260	-66.6	6	137	0.16	227	12	0.001
24000	22666	-18.8	19.5	304	0.52	34	9	0.125	61924	60512	-65.6	8	118	0.21	208	12	0.001
24959	23580	-20.6	20	307	0.53	37	9	0.107	62000	60591	-65.2	9.5	114	0.25	204	12	0.001
25000	23619	-20.6	20.3	306	0.54	36	9	0.107	62641	61251	-63	9	130	0.24	220	11	0.001

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ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
2372	2265	27	1.9	110	0.05	200	31	11.051
2393	2285	27.4	2	187	0.05	277	5	1.825
2500	2386	26.6	2.2	181	0.06	271	9	3.134
2624	2503	26.2	1	179	0.03	269	12	4.081
2874	2740	25.5	1	60	0.03	150	15	4.894
2946	2808	25.3	1	72	0.03	162	17	5.481
3000	2859	25.3	2.4	82	0.06	172	17	5.481
3500	3330	26.1	4.8	56	0.13	146	13	4.395
4000	3799	25.5	8.6	55	0.23	145	11	3.589
4397	4171	25.9	12	58	0.32	148	11	3.675
4500	4268	25.7	12.3	64	0.33	154	11	3.632
5000	4734	25.5	15.9	69	0.42	159	7	2.284
5058	4789	25.5	16	73	0.43	163	5	1.631
5150	4874	25.6	17	74	0.45	164	2	0.656
5294	5008	25.4	20	69	0.53	159	2	0.649
5500	5200	24.9	22.8	64	0.61	154	2	0.63
6000	5665	23.7	20.3	66	0.54	156	2	0.586
6500	6131	22.8	18.5	72	0.49	162	2	0.555
7000	6597	21.6	14.9	66	0.4	156	3	0.774
7500	7063	20.6	8.2	76	0.22	166	2	0.485
8000	7529	19.2	6.5	88	0.17	178	2	0.445
8500	7996	17.9	9	101	0.24	191	2	0.41
9000	8463	16.7	12.5	74	0.33	164	2	0.38
9500	8930	15.4	10.5	86	0.28	176	3	0.525
10000	9398	14.1	12.2	88	0.32	178	4	0.643
10500	9867	13	9.3	121	0.25	211	5	0.749
10525	9890	13	10	122	0.27	212	5	0.749
11000	10335	11.6	14.6	107	0.39	197	8	1.092
11500	10805	10.2	13.7	88	0.36	178	11	1.369
12000	11275	8.9	15.5	97	0.41	187	13	1.482
12500	11745	7.7	19.4	97	0.52	187	16	1.681
12666	11901	7.2	19	99	0.51	189	17	1.726
13000	12216	6.4	18.7	103	0.5	193	17	1.634
13500	12687	5.3	20.3	112	0.54	202	15	1.336
14000	13159	3.9	22.1	104	0.59	194	18	1.454
14218	13364	3.2	20	108	0.53	198	18	1.384
14500	13631	3	16.8	98	0.45	188	14	1.061
15000	14102	2	14.1	80	0.38	170	14	0.988
16000	15046	0.1	10.6	40	0.28	130	8	0.493
16079	15120	-0.1	10	40	0.27	130	7	0.425
17000	15990	-2.4	17	29	0.45	119	8	0.41
18000	16934	-4	21.7	36	0.58	126	6	0.273
19000	17877	-5.9	21.3	47	0.57	137	8	0.315
19450	18301	-6.7	21	53	0.56	143	7	0.259
20000	18820	-7.8	19.3	42	0.51	132	7	0.238
20114	18927	-8	20	42	0.53	132	7	0.235
21000	19763	-10.3	18	35	0.48	125	7	0.196
22000	20708	-12.7	18.4	49	0.49	139	7	0.162
23000	21655	-15.2	17.4	46	0.46	136	7	0.132
23693	22313	-17.1	18	47	0.48	137	7	0.112
24000	22604	-17.9	16.1	48	0.43	138	7	0.105
25000	23555	-20.3	15.1	49	0.4	139	7	0.086

ZFT	Hpf	Tmp	Kts	DIR	Grad	GDr	Rel	Hum
25033	23587	-20.4	15	48	0.4	138	7	0.085
26000	24508	-22.7	14.3	53	0.38	143	6	0.059
27000	25462	-25.2	13.5	45	0.36	135	6	0.047
28000	26419	-27.8	9.7	33	0.26	123	5	0.031
29000	27377	-30.2	9.3	351	0.25	81	4	0.02
30000	28337	-32.4	9	329	0.24	59	4	0.016
31000	29298	-34.9	9	329	0.24	59	4	0.013
31813	30080	-36.5	11	313	0.29	43	3	0.008
32000	30260	-37	12.2	312	0.32	42	3	0.008
33000	31224	-39.6	11.8	313	0.31	43	4	0.008
33105	31325	-40	11	315	0.29	45	4	0.008
34000	32190	-42.4	10.2	319	0.27	49	4	0.006
34063	32251	-42.6	9	319	0.24	49	4	0.006
35000	33158	-44.1	12.8	309	0.34	39	4	0.005
35886	34014	-45.6	12	304	0.32	34	4	0.004
36000	34125	-45.7	13.1	305	0.35	35	4	0.004
37000	35091	-48	11.6	297	0.31	27	5	0.004
38000	36058	-50.3	12.3	247	0.33	337	6	0.004
38455	36500	-51.6	23	235	0.61	325	7	0.004
39000	37031	-52.3	12.5	270	0.33	0	7	0.003
40000	38009	-53	16.2	290	0.43	20	8	0.004
40680	38676	-53.8	15	295	0.4	25	8	0.003
41000	38990	-53.2	13.6	274	0.36	4	8	0.003
41500	39481	-53.4	15	247	0.4	337	8	0.003
42000	39972	-54	16.4	235	0.44	325	8	0.003
43000	40960	-56.1	15.7	261	0.42	351	9	0.003
44000	41957	-57.7	9.8	256	0.26	346	10	0.002
45000	42961	-59.3	10.6	234	0.28	324	10	0.002
46000	43972	-60.9	23.1	228	0.61	318	11	0.002
46681	44665	-62.1	21	243	0.56	333	11	0.002
47000	44991	-62.1	19.1	248	0.51	338	11	0.002
48000	46016	-63.6	18.3	232	0.49	322	12	0.001
48993	47042	-65.7	21	239	0.56	329	13	0.001
49000	47049	-65.7	21.2	239	0.56	329	13	0.001
50000	48090	-66.6	12.2	258	0.32	348	13	0.001
51000	49135	-67.3	8.4	216	0.22	306	13	0.001
51733	49903	-67.9	5	217	0.13	307	13	0.001
52000	50183	-67.9	5.7	237	0.15	327	13	0.001
53000	51232	-67.7	8.3	159	0.22	249	13	0.001
54000	52282	-68.6	21.3	182	0.57	272	14	0.001
54779	53102	-69	8	174	0.21	264	14	0.001
55000	53336	-68.7	8.5	151	0.23	241	14	0.001
56000	54391	-69.7	17.6	186	0.47	276	14	0.001
56500	54921	-70.4	15	205	0.4	295	14	0.001
56636	55066	-70.5	14	211	0.37	301	14	0.001
57000	55452	-70	8.8	204	0.23	294	14	0.001
58000	56511	-69.8	6.4	345	0.17	75	14	0.001
58016	56528	-69.8	6	347	0.16	77	14	0.001
59000	57561	-66.7	12.9	15	0.34	105	13	0.001
59582	58164	-63.8	12	49	0.32	139	11	0.001
60000	58594	-64.3	13	71	0.35	161	11	0.001
61000	59629	-66	10.3	108	0.27	198	12	0.001
61228	59865	-65.7	7	86	0.19	176	12	0.001

Appendix J

Interior reverberation time measurements.

Reverberation measurements for the Subjective Room with no people in the chairs

	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.73	0.74	1.11	1.08	1.1	1.09
80	0.59	0.6	0.65	0.66	0.73	0.75
100	0.57	0.58	0.64	0.63	0.67	0.66
125	0.54	0.55	0.57	0.55	0.6	0.6
160	0.49	0.49	0.48	0.49	0.45	0.46
200	0.6	0.6	0.62	0.62	0.67	0.67
250	0.49	0.48	0.63	0.64	0.62	0.63
315	0.66	0.66	0.52	0.51	0.68	0.68
400	0.52	0.52	0.59	0.59	0.57	0.58
500	0.47	0.47	0.46	0.46	0.48	0.48
630	0.46	0.47	0.47	0.47	0.45	0.45
800	0.44	0.43	0.47	0.46	0.5	0.47
1000	0.4	0.4	0.45	0.45	0.47	0.47
1250	0.4	0.4	0.47	0.47	0.49	0.48
1600	0.44	0.44	0.49	0.5	NaN	NaN
2000	0.39	0.4	0.45	0.47	NaN	NaN
2500	0.42	0.43	0.46	0.47	0.46	0.47
3150	0.43	0.43	0.48	0.49	0.48	0.5
4000	0.46	0.47	0.46	0.47	0.49	0.47
5000	0.46	0.46	0.46	0.46	0.48	0.48

Reverberation measurements for the Subjective Room with 5 people in the chairs

	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.7	0.7	1.11	1.08	1.15	1.14
80	0.63	0.63	0.7	0.69	0.82	NaN
100	0.55	0.55	0.65	0.67	0.74	0.74
125	0.58	0.59	0.62	0.62	0.61	0.6
160	0.47	0.48	0.49	0.49	0.42	0.47
200	0.52	0.42	0.72	0.72	0.72	0.76
250	0.52	0.55	0.53	0.6	0.59	0.63
315	0.64	0.67	0.52	0.53	0.52	0.53
400	0.52	0.49	0.44	0.45	0.55	0.53
500	0.44	0.44	0.44	0.43	0.47	0.45
630	0.53	0.55	0.48	0.51	0.49	0.5
800	0.44	0.46	0.43	0.47	0.46	0.45
1000	0.39	0.4	0.41	0.41	0.42	0.44
1250	0.42	0.44	0.47	0.45	0.52	0.47
1600	0.4	0.42	0.51	0.49	0.54	0.49
2000	0.4	0.41	0.47	0.46	NaN	0.5
2500	0.4	0.41	0.43	0.43	0.44	0.45
3150	0.42	0.43	0.46	0.47	0.48	0.48
4000	0.43	0.45	0.43	0.45	0.43	0.45
5000	0.44	0.44	0.42	0.45	0.45	0.49

Reverberation measurements for the Front Bedroom, Window Closed, Nominal Foam

	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.68	0.66	0.92	0.92	0.97	0.98
80	1.29	1.28	1.08	1.06	1.05	1.04
100	0.51	0.53	0.61	0.7	0.72	NaN
125	0.57	0.58	0.51	0.51	0.47	0.46
160	0.36	0.36	0.43	0.42	0.41	0.41
200	0.72	0.73	0.68	0.67	NaN	0.68
250	0.73	0.73	0.85	0.83	1.01	0.99
315	0.48	0.48	0.74	0.75	0.76	0.76
400	0.62	0.6	0.83	0.82	0.86	0.85
500	0.62	0.62	0.83	0.83	0.82	0.82
630	0.9	0.9	0.68	0.68	0.68	0.67
800	0.78	0.79	0.69	0.72	0.65	0.73
1000	0.7	0.7	0.7	0.7	0.69	0.67
1250	0.58	0.58	0.66	0.64	0.69	0.68
1600	0.7	0.71	0.65	0.66	0.68	0.72
2000	0.65	0.65	0.69	0.69	0.68	0.68
2500	0.55	0.56	0.55	0.56	0.57	0.6
3150	0.54	0.54	0.58	0.59	0.5	0.63
4000	0.53	0.53	0.55	0.55	0.54	0.55
5000	0.51	0.51	0.52	0.53	0.54	0.54

Reverberation measurements for the Front Bedroom, Window Closed, Reduced Foam

	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.84	0.86	0.87	0.9	0.91	0.94
80	1.38	1.42	1.2	1.22	1.29	1.29
100	0.61	0.6	0.82	0.78	0.87	0.75
125	0.53	0.53	0.63	0.62	0.6	0.57
160	0.29	0.28	0.4	0.4	0.36	0.34
200	0.6	0.6	0.69	0.69	0.64	0.63
250	0.86	0.86	1.01	1.01	1.02	1.02
315	0.95	0.92	0.92	0.9	0.96	0.98
400	1.04	1.03	1.16	1.16	1.09	1.08
500	1.03	1.02	1.01	0.99	1	0.97
630	0.89	0.88	0.98	1	0.93	0.96
800	0.99	1	0.94	0.96	0.89	0.93
1000	0.89	0.9	1.1	1.07	1.15	1.12
1250	0.89	0.89	0.91	0.94	0.93	0.99
1600	0.99	0.98	1.03	1.03	1	0.98
2000	1.06	1.06	1.05	1.05	1.04	1.06
2500	0.89	0.88	0.89	0.89	0.91	0.88
3150	0.85	0.83	0.88	0.88	0.87	0.88
4000	0.79	0.78	0.9	0.92	0.91	0.9
5000	0.81	0.83	0.81	0.79	0.82	0.79

Reverberation measurements for the Back Bedroom, Window Closed, Nominal Foam

	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.67	0.67	0.98	0.98	0.98	0.99
80	0.53	0.51	0.39	0.38	0.52	0.49
100	0.55	0.55	0.39	0.38	0.36	0.36
125	0.4	0.42	0.29	0.42	0.35	0.44
160	0.25	0.25	0.4	0.41	0.5	0.5
200	0.74	0.74	0.61	0.61	0.61	0.61
250	0.65	0.65	0.6	0.6	0.53	0.53
315	0.75	0.75	0.73	0.73	0.74	0.75
400	0.68	0.68	0.72	0.73	0.66	0.65
500	0.66	0.67	0.78	0.79	0.85	0.86
630	0.8	0.8	0.78	0.78	0.82	0.82
800	0.68	0.68	0.66	0.66	0.63	0.64
1000	0.62	0.62	0.61	0.61	0.6	0.59
1250	0.62	0.62	0.6	0.6	0.62	0.61
1600	0.66	0.66	0.65	0.65	0.69	0.7
2000	0.62	0.62	0.63	0.63	0.7	0.7
2500	0.49	0.49	0.56	0.55	0.57	0.57
3150	0.49	0.49	0.54	0.55	0.55	0.56
4000	0.5	0.51	0.5	0.49	0.52	0.52
5000	0.45	0.46	0.46	0.47	0.49	0.5

Reverberation measurements for the Back Bedroom, Window Open, Nominal Foam

	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.34	0.34	0.43	0.43	NaN	NaN
80	0.31	0.32	0.42	0.44	0.44	0.46
100	0.3	0.29	0.44	0.44	0.38	0.38
125	0.5	0.74	0.61	0.6	0.56	0.56
160	0.23	0.23	0.32	0.33	0.37	0.36
200	0.49	0.44	0.61	0.57	0.56	NaN
250	0.6	0.6	0.7	0.69	0.69	0.67
315	0.72	0.72	0.69	0.69	0.72	0.72
400	0.7	0.7	0.66	0.64	0.68	0.66
500	0.6	0.61	0.58	0.59	0.59	NaN
630	0.55	0.55	0.64	0.61	0.64	0.61
800	0.73	0.75	0.65	0.65	0.67	0.68
1000	0.61	0.6	0.64	0.63	0.61	0.6
1250	0.59	0.58	0.6	0.57	0.62	0.57
1600	0.57	0.57	0.6	0.58	0.61	0.6
2000	0.48	0.5	0.57	0.56	0.55	0.56
2500	0.47	0.46	0.48	0.5	0.51	0.53
3150	0.47	0.44	0.49	0.46	0.51	0.48
4000	0.43	0.41	0.5	0.49	0.53	0.53
5000	0.43	0.41	0.44	0.42	0.46	0.43

Reverberation measurements for the Back Bedroom, Window Closed, Added Foam

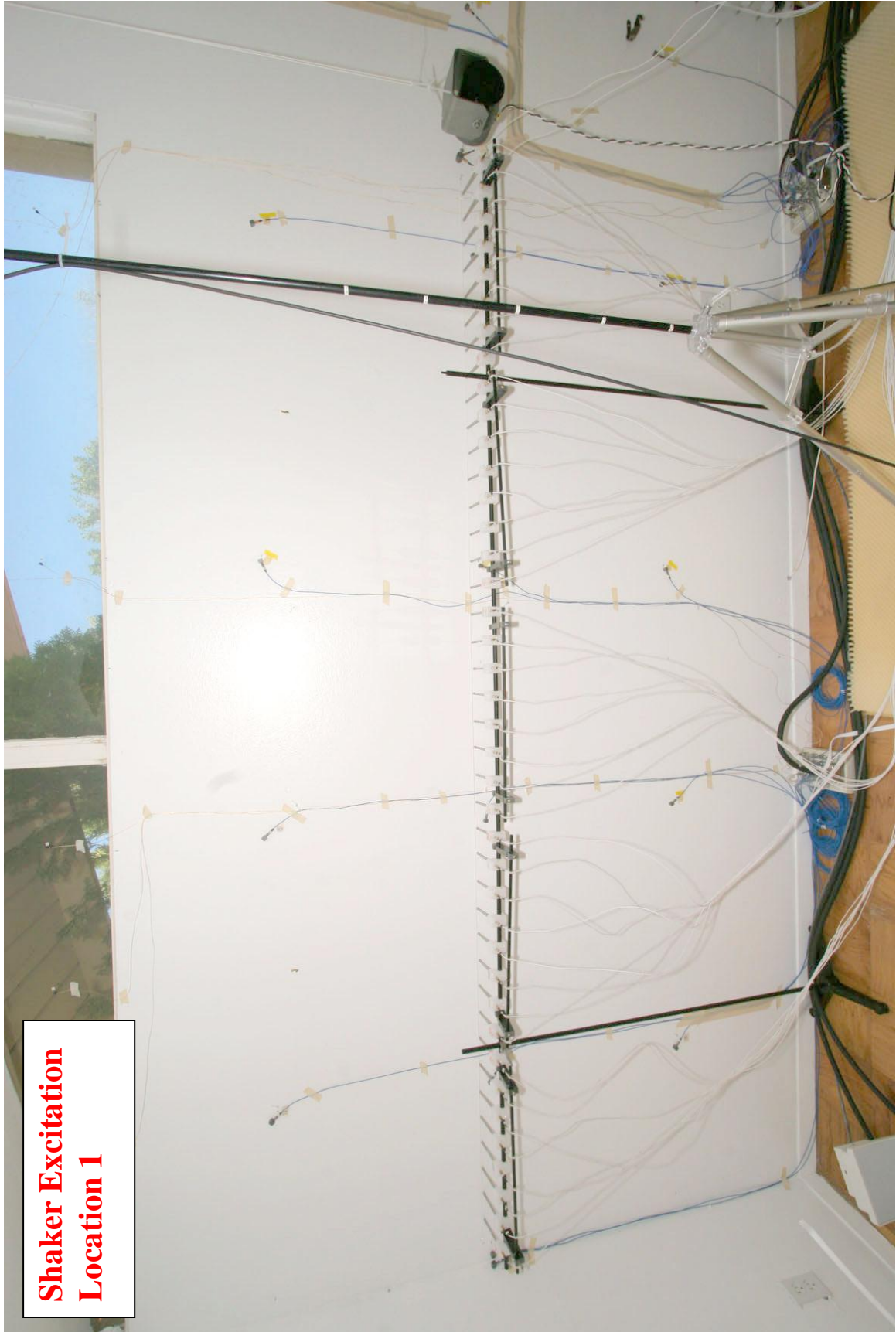
	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.36	0.36	0.45	0.45	NaN	0.64
80	0.3	0.3	0.36	0.36	0.39	0.4
100	0.31	0.33	0.31	0.37	0.26	0.45
125	0.46	0.46	0.38	0.38	0.43	0.43
160	0.18	0.19	0.37	0.37	NaN	NaN
200	0.32	0.34	0.49	0.57	0.45	NaN
250	0.26	0.26	0.46	0.46	0.45	0.45
315	0.59	0.59	0.52	0.52	0.53	0.53
400	0.61	0.61	0.5	0.5	0.48	0.48
500	0.47	0.46	0.5	0.49	0.49	0.47
630	0.5	0.5	0.49	0.49	0.49	0.49
800	0.55	0.55	0.48	0.49	0.52	0.54
1000	0.53	0.55	0.52	0.52	0.51	0.5
1250	0.48	0.49	0.44	0.43	0.44	0.44
1600	0.49	0.49	0.47	0.46	0.52	0.51
2000	0.36	0.36	0.44	0.44	0.47	0.46
2500	0.38	0.39	0.41	0.41	0.39	0.39
3150	0.35	0.36	0.4	0.4	0.41	0.41
4000	0.35	0.35	0.38	0.39	0.41	0.43
5000	0.35	0.35	0.36	0.36	0.38	0.37

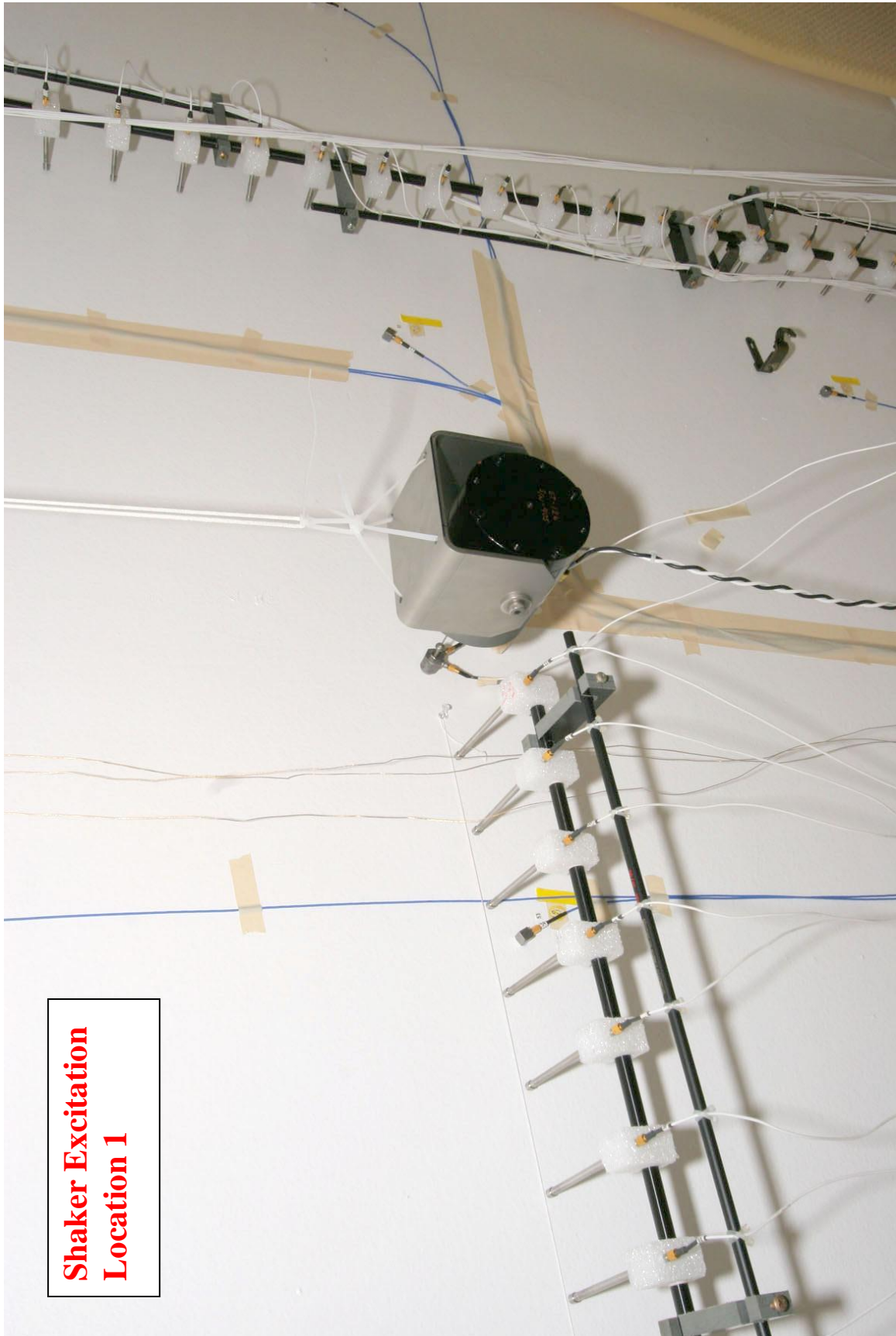
Reverberation measurements for the Back Bedroom, Window Open, Added Foam

	EDT	EDT (repeat)	T20	T20 (repeat)	T30	T30 (repeat)
63	0.33	0.33	0.35	0.38	NaN	NaN
80	0.29	0.3	0.35	0.34	0.38	0.36
100	0.3	0.31	0.38	0.4	0.45	0.48
125	0.48	0.48	0.39	0.4	0.46	0.45
160	0.2	0.19	0.31	0.32	NaN	NaN
200	0.31	0.31	0.54	0.55	NaN	NaN
250	0.32	0.31	0.48	0.47	0.45	0.44
315	0.52	0.53	0.48	0.48	0.47	0.46
400	0.57	0.57	0.47	0.47	0.47	0.47
500	0.46	0.46	0.51	0.51	0.5	0.51
630	0.47	0.46	0.54	0.52	0.55	0.55
800	0.58	0.56	0.51	0.5	0.57	NaN
1000	0.49	0.47	0.49	0.5	0.47	0.47
1250	0.48	0.48	0.44	0.46	0.44	0.44
1600	0.47	0.48	0.47	0.49	0.48	0.5
2000	0.34	0.34	0.45	0.48	0.46	0.5
2500	0.37	0.36	0.4	0.42	0.43	0.44
3150	0.36	0.36	0.38	0.41	0.39	0.42
4000	0.34	0.35	0.37	0.37	0.38	0.39
5000	0.34	0.35	0.35	0.36	0.37	0.37

Appendix K

Shaker Excitation Location Pictures.







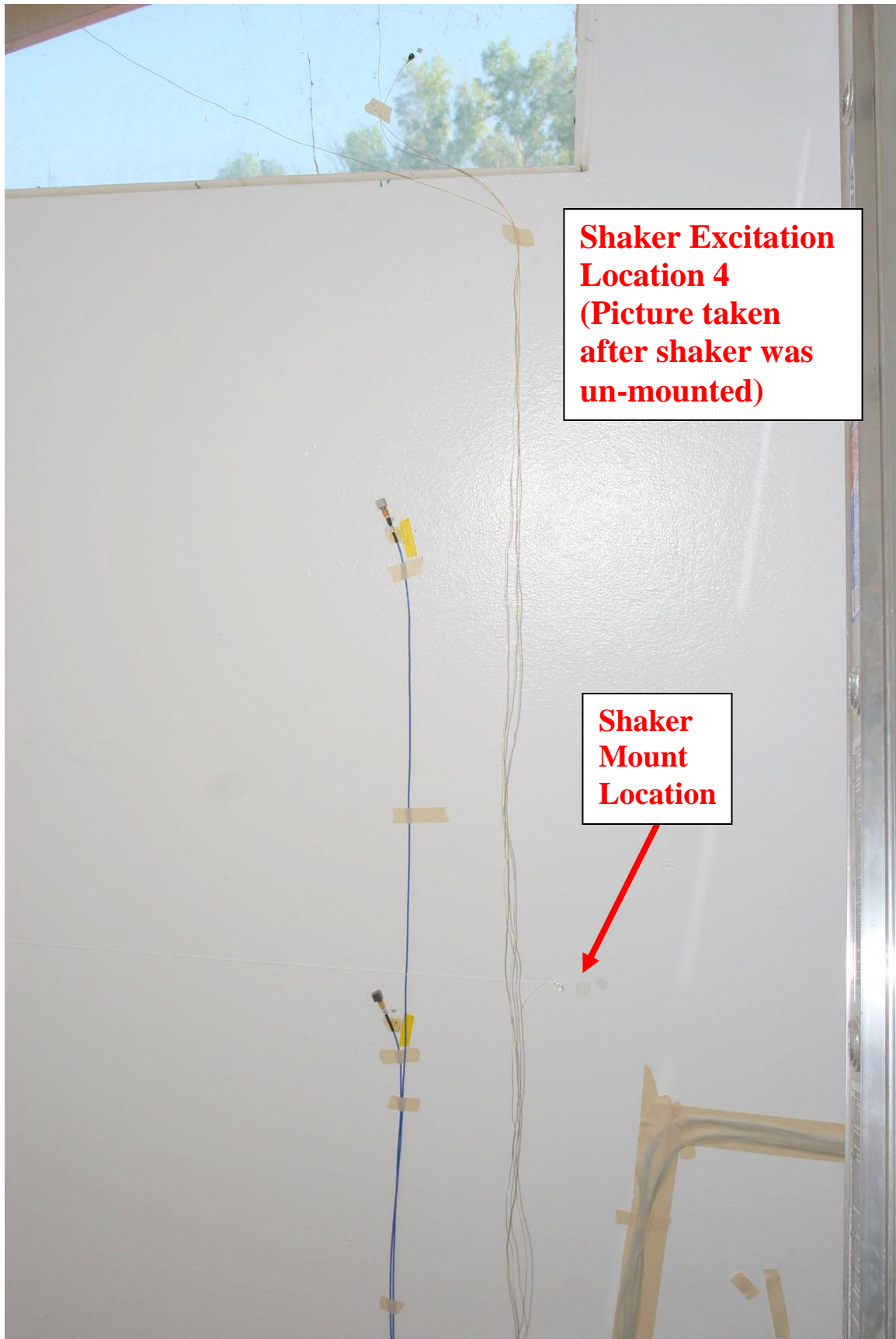
**Shaker Excitation
Location 2**

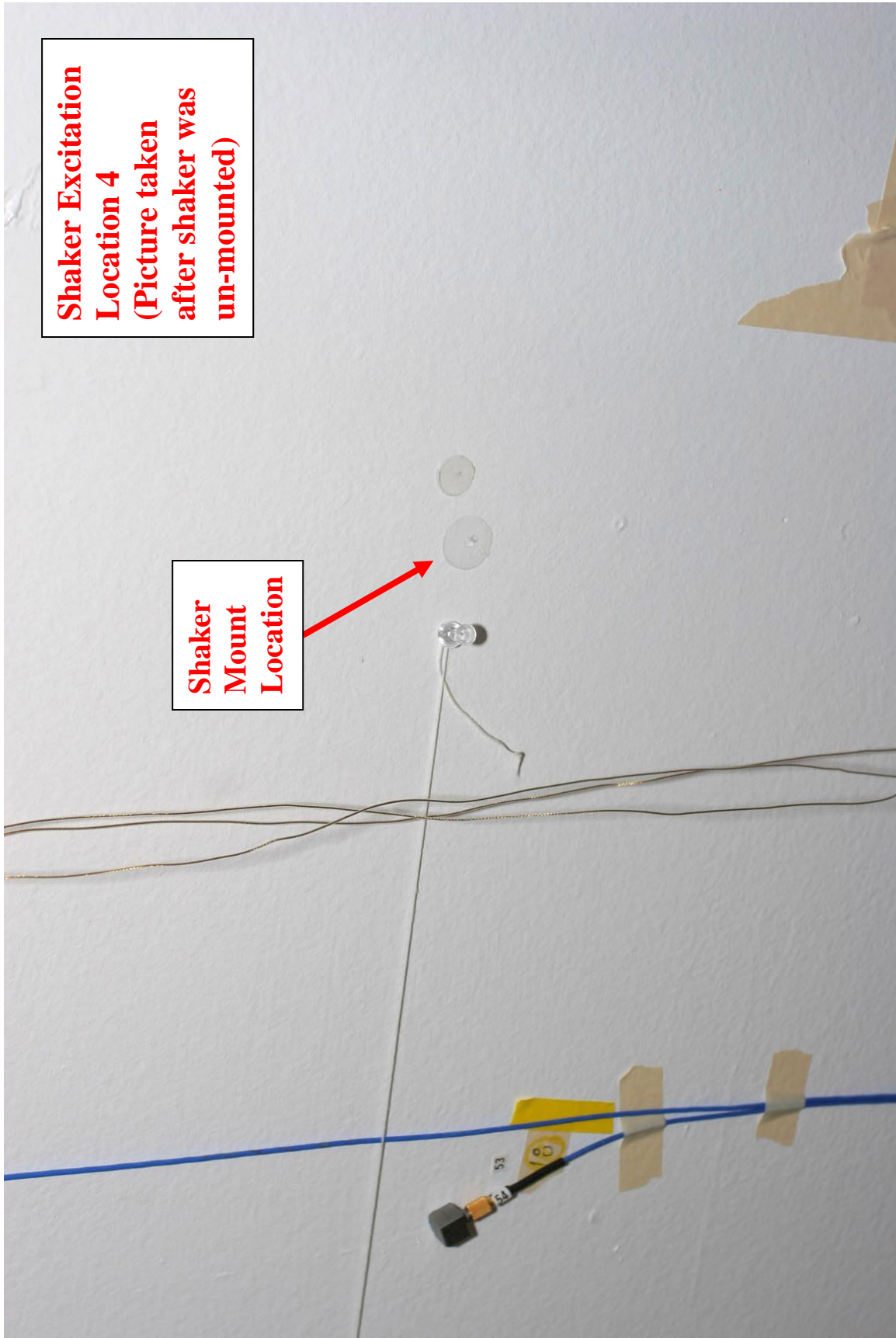


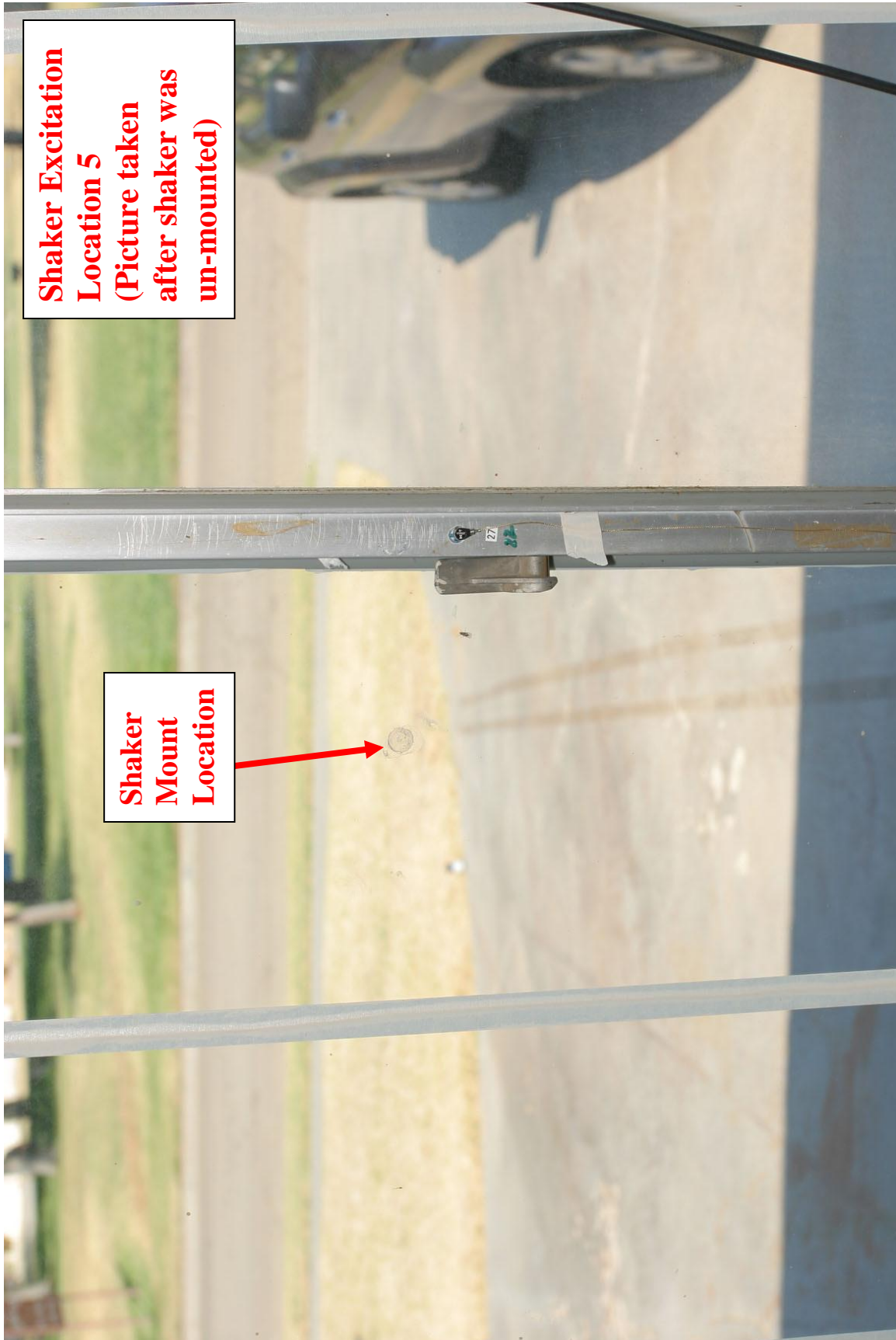


**Shaker Excitation
Location 3**









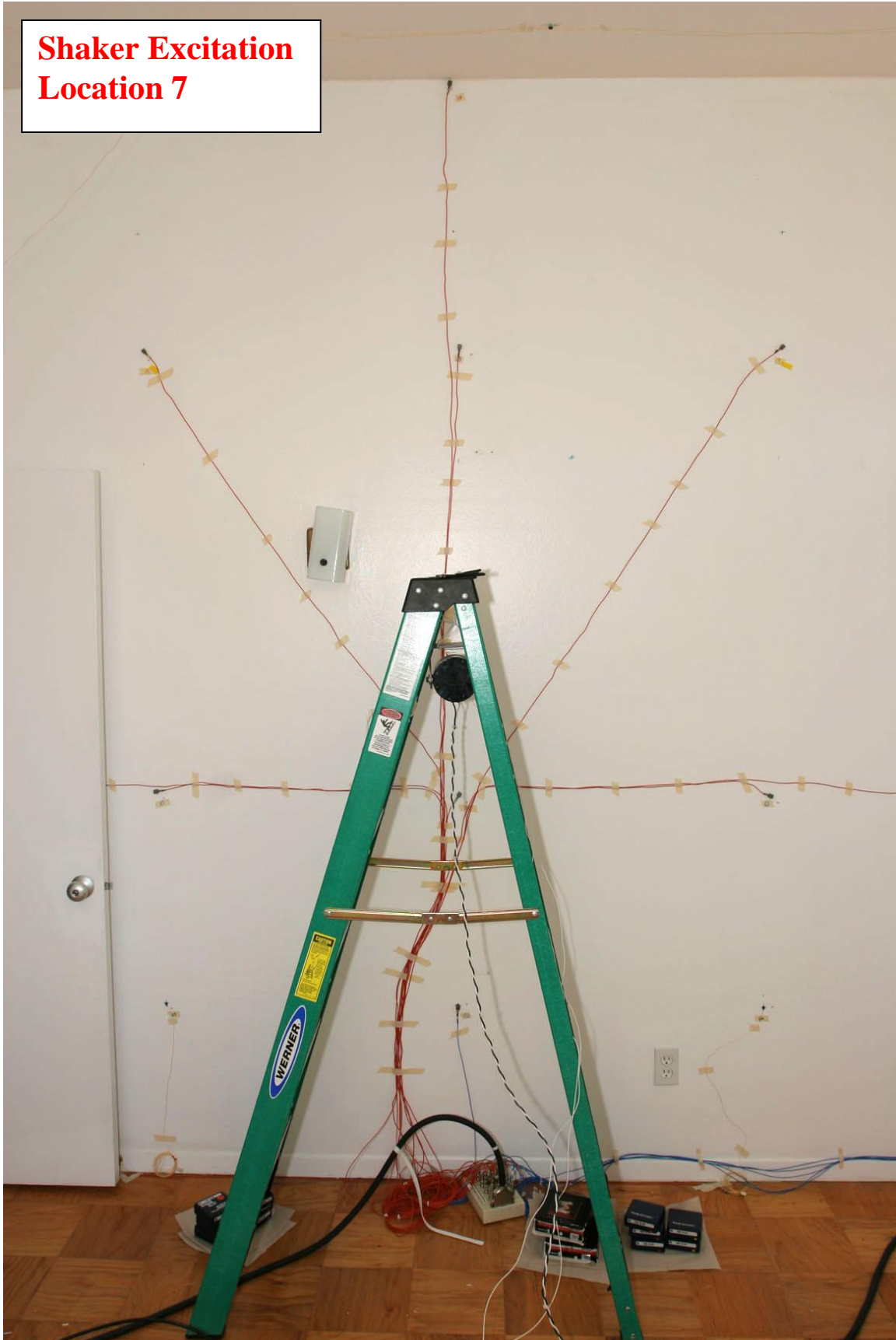


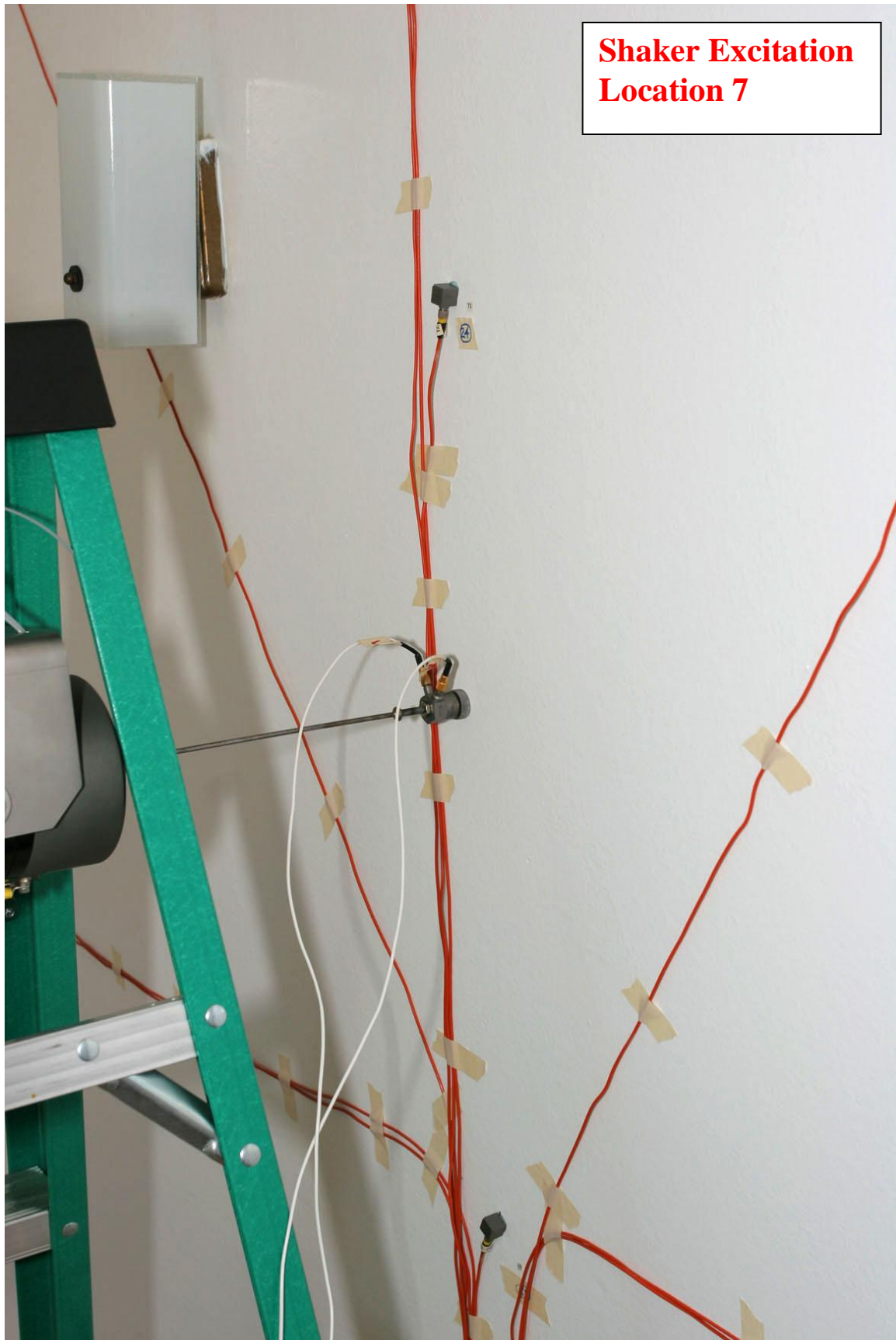
**Shaker Excitation
Location 6**

Shaker Excitation Location 6

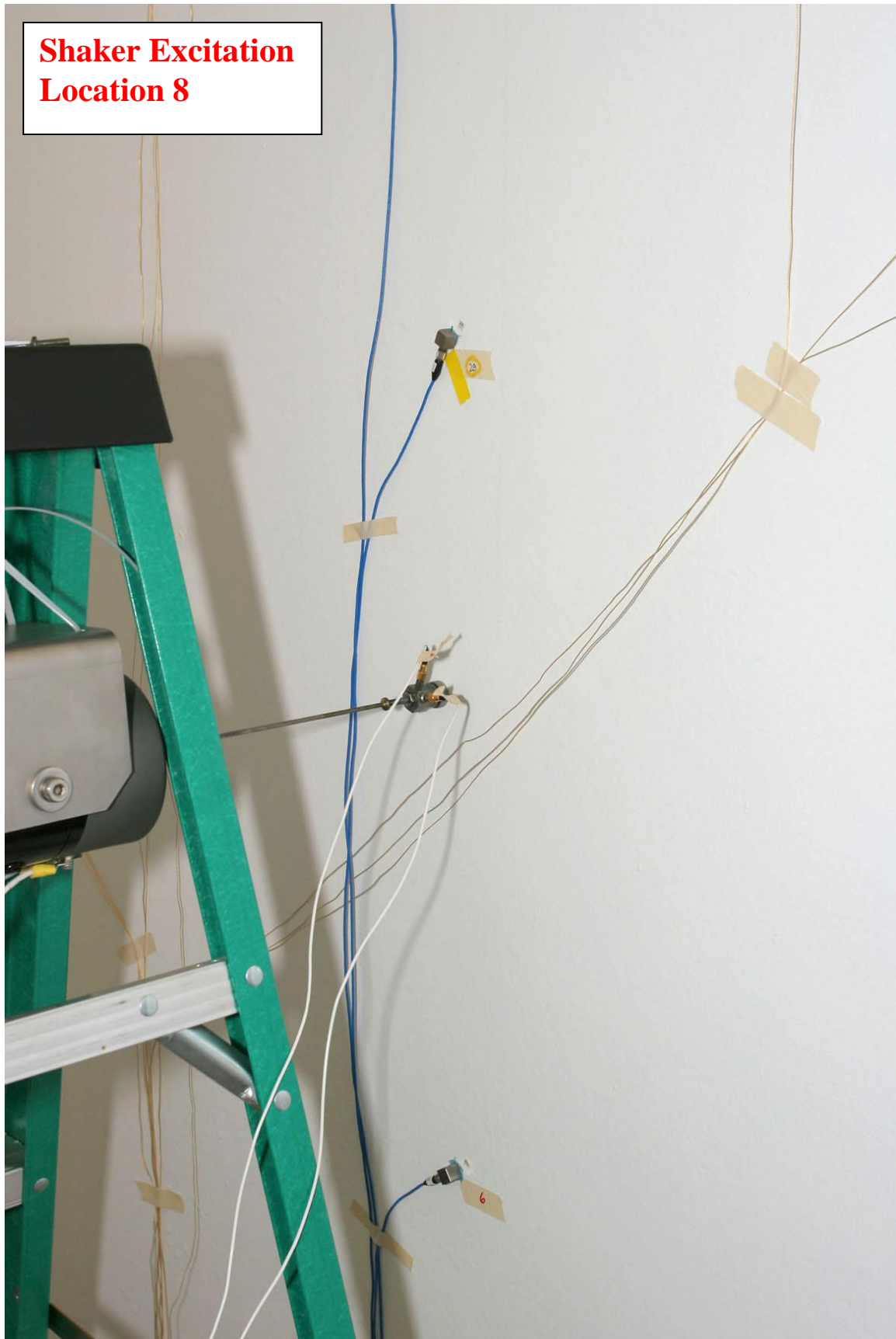


**Shaker Excitation
Location 7**



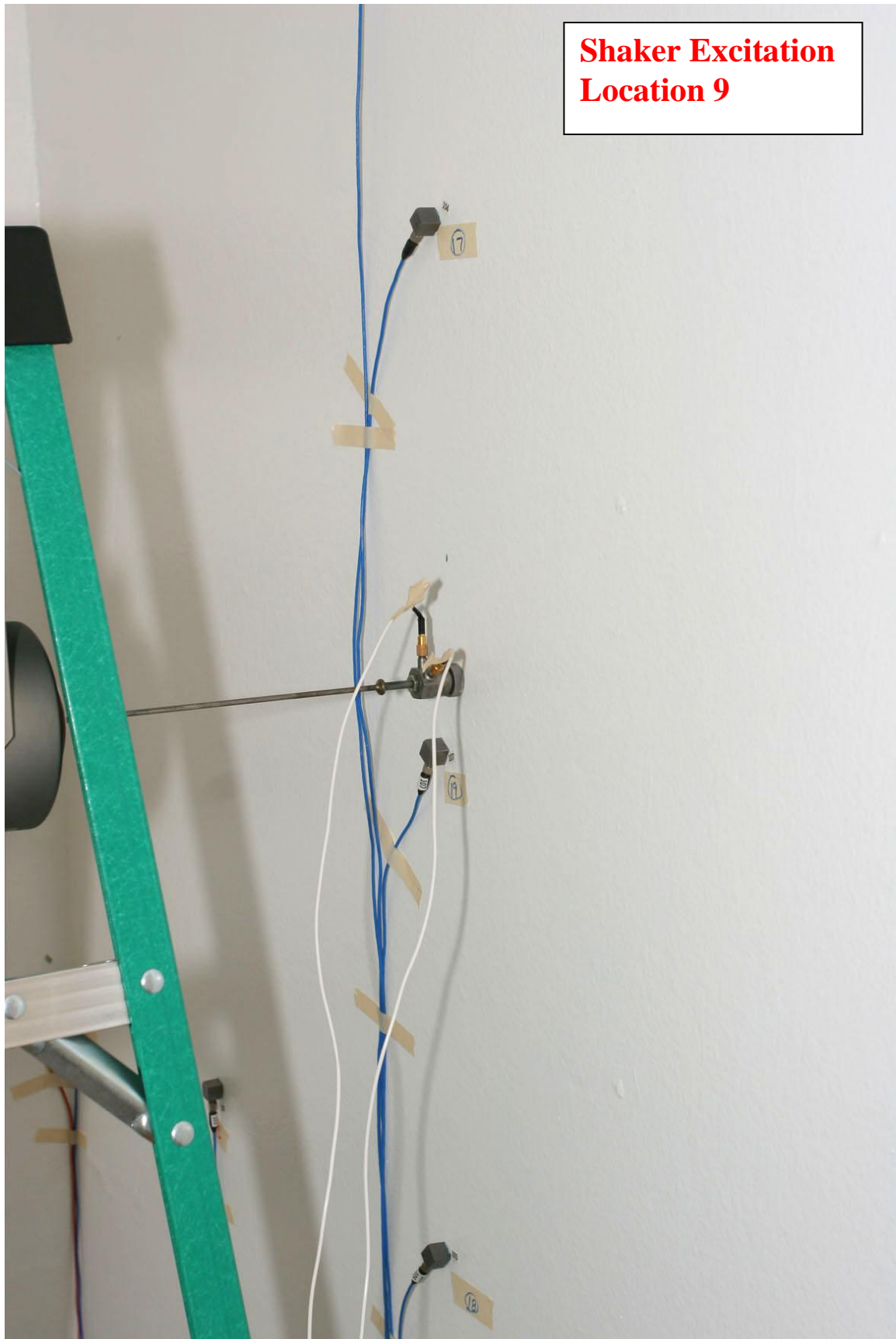






**Shaker Excitation
Location 9**





**Shaker Excitation
Location 10**



**Shaker Excitation
Location 10**



Appendix L

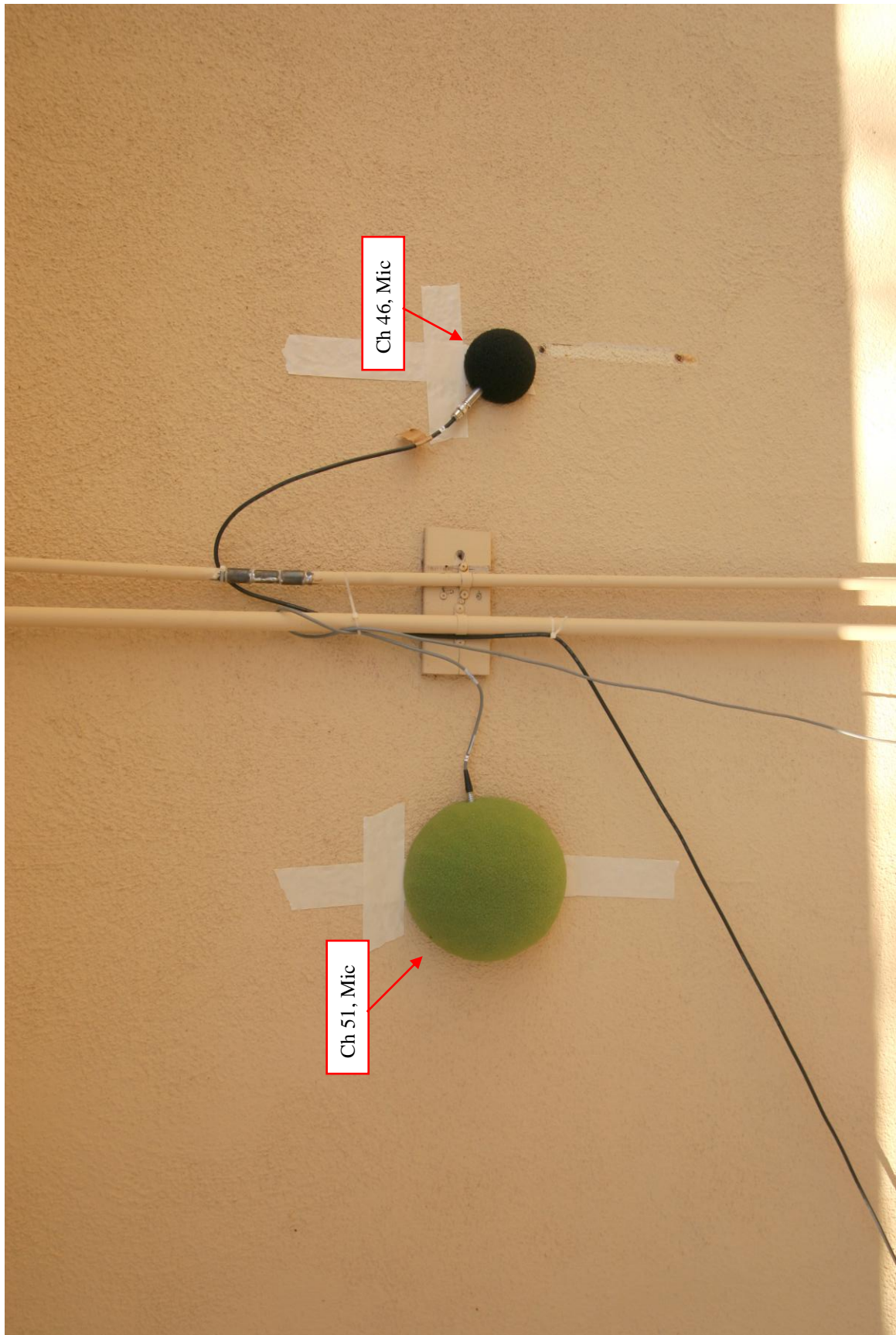
Transducer locations during the March 2006 pretest.

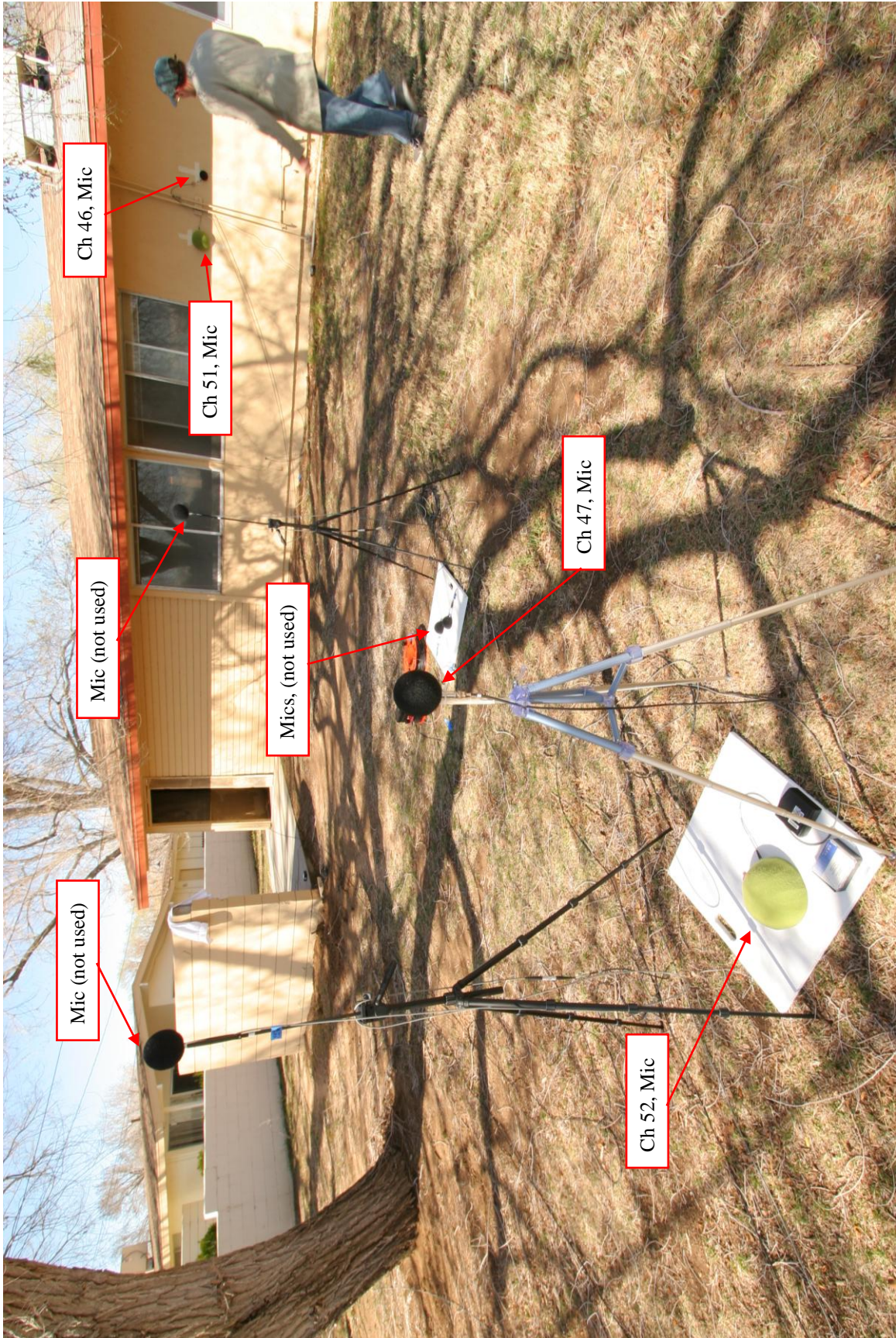
March 2006 pretest channel table

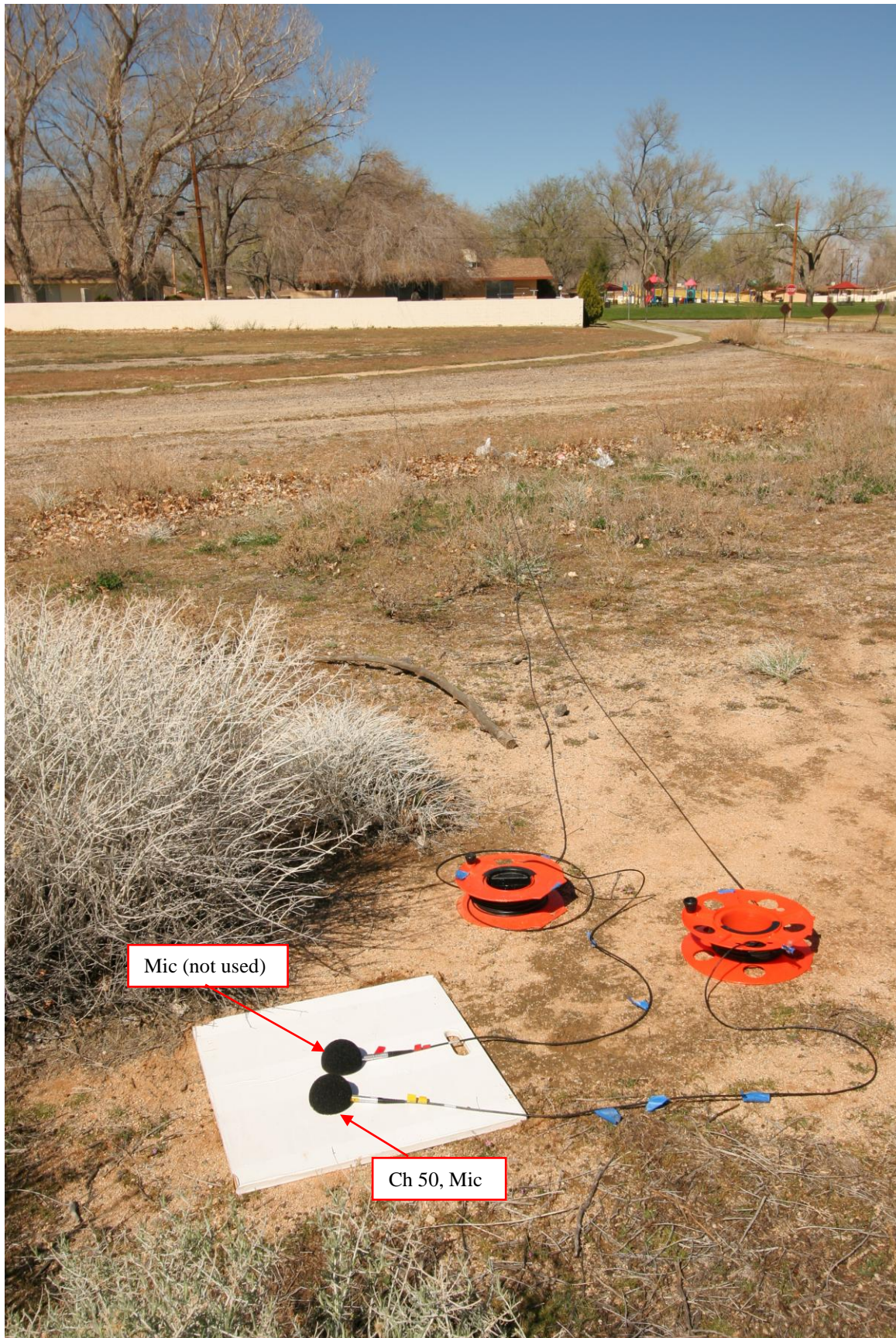
NI Daq Channel	Transducer Type	Transducer Model	Serial Number	Preamplifier Serial Number	Sensitivity	Location Description	Measurement 1 height from floor feet	Measurement 2 feet
1	Accel	Endevco 2250a-10	12932	N/A	9.84	Window header above rear fixed window	6.67	5.8 (side wall)
2	Accel	Endevco 2250a-10	12900	N/A	10.05	Top third of rear fixed window	5.62	5.8 (side wall)
3	Accel	Endevco 2250a-10	AKBL6	N/A	10.34	Mid third of rear fixed window	4.65	5.8 (side wall)
4	Accel	Endevco 2250a-10	12899	N/A	10.27	Bottom third or rear fixed window	3.63	5.8 (side wall)
5	Accel	Endevco 2250a-10	11101	N/A	10.03	Back room, ceiling above window	2.92 (rear wall)	5.62 (side wall)
6	Accel	Endevco 2250a-10	14182	N/A	10.07	Back room, back wall stud, top	5.63	2.3 (side wall)
7	Accel	Endevco 2250a-10	EF01	N/A	9.9	Back room, back wall stud, mid	4.63	2.3 (side wall)
8	Microphone	Type 4193 / Type 2669 / LF Adapt	368556	2404977	28.7	Gulfsream Mic 1 near subjective window		
9	Accel	Endevco 2250a-10	12879	N/A	10.13	Back room, back wall non-stud, top	5.61	1.31
10	Accel	Endevco 2250a-10	11121	N/A	10.11	Back room, back wall non-stud, mid	4.61	1.31
11	Accel	Endevco 2250a-10	11079	N/A	10.01	Back room, side wall window	7.61	3.69 (rear wall)
12	Accel	Endevco 2250a-10	12992	N/A	10	Back room, side wall window	7.97	8.1
13	Accel	Endevco 2250a-10	12915	N/A	9.98	Back room, side wall array, rear	4.6	1.94
14	Accel	Endevco 2250a-10	12903	N/A	10.3	Back room, side wall array	4.6	3.2
15	Microphone	Type 4193 / Type 2669	236855	2404974	59	Gulfsream Mic 2 near entry door		
16	Accel	Endevco 2250a-10	11061	N/A	10.02	Back room, side wall array	4.6	5.71
17	Accel	Endevco 2250a-10	12901	N/A	10.11	Back room, side wall array	4.6	6.98
18	Accel	Endevco 2250a-10	12919	N/A	9.99	Back room, side wall array, forward	4.6	8.26 (rear wall)
19	Accel	Endevco 2250a-10	12945	N/A	9.83	Back room, front wall, right	3.68	1.65 (side wall)
20	Accel	Endevco 2250a-10	12934	N/A	10.15	Back room, front wall, top	8.1	5.08
21	Accel	Endevco 2250a-10	12935	N/A	10.03	Back room, front wall, left	6.61	9.16
22	Accel	Endevco 2250a-10	12902	N/A	10.17	Front room, side wall, forward top	5.3	5.09 (for wall)
23	Array Mic	PCB 130 Series	5131	12960	17	string 4 mic 3		
24	Accel	Endevco 2250a-10	12878	N/A	9.93	Front room, fixed window center	4.68	7.25 (side wall)
25	Accel	Endevco 2250a-10	12916	N/A	9.98	Front room, side window center	4.58	4.31 (side wall)
26	Accel	Endevco 2250a-10	12931	N/A	10.17	Front room, forward wall mid	4.38	1.45
27	Accel	Endevco 2250a-10	12941	N/A	9.94	Front room, side wall, aft mid	4.26	10.28 (for wall)
28	Array Mic	PCB 130 Series	5200	12962	28.5	string 1 mic 1, window top		
29	Array Mic	PCB 130 Series	5201	12965	24.9	string 1 mic 2		
30	Array Mic	PCB 130 Series	5204	12957	23.8	string 1 mic 3		
31	Array Mic	PCB 130 Series	5203	12942	20.4	string 2 mic 1, back wall stud top		
32	Array Mic	PCB 130 Series	2715	12951	21.4	string 2 mic 2		
33	Array Mic	PCB 130 Series	2716	12954	19.6	string 2 mic 3		
34	Array Mic	PCB 130 Series	2719	12941	23.0	string 2 mic 4, back wall stud bottom		
35	Array Mic	PCB 130 Series	2720	10551	15.9	string 3 mic 2, back wall non-stud		
36	Array Mic	PCB 130 Series	2751	12955	20.9	string 3 mic 3		
37	Array Mic	PCB 130 Series	2930	10719	19.3	string 4 mic 2, front room side wall		
38	Array Mic	PCB 130 Series	2927	12961	21.7	string 4 mic 4		
39	Array Mic	PCB 130 Series	5220	12963	22.5	Subjective living area, collocated with B&K #1		
40	Microphone	Gras 40AQ / 26CA	48291	58461	45.8	Back bedroom, by the closet/window		
41	Microphone	Gras 40AQ / 26CA	48292	58462	47.6	Back bedroom, by the side wall		
42	Microphone	Gras 40AQ / 26CA	48293	58463	46.7	Back bedroom, wall nearfield		
43	Microphone	Gras 40AQ / 26CA	48294	58464	45.8	Front bedroom		
44	Microphone	Gras 40AQ / 26CA	48295	58465	44.3	Living area in front of kitchen wall		
45	Microphone	Gras 40AQ / 26CA	48296	58466	48.2	Outside on back wall of house, mid way up		
46	Microphone	Gras 40AQ / 26CA	48297	58467	43.1	Outside in yard, head height on tripod		
47	Microphone	Gras 40AQ / 26CA	48298	58468	45.5	N/A		
48	IRIG Time	N/A	N/A	N/A	1.0	Subjective living area, collocated with gras #1	N/A	N/A
49	Microphone	Type 4193 / Type 2669	2151232	1828322	63.8	Outside, far field microphone		
50	Microphone	Type 4193 / Type 2669 / LF Adapt	Unknown	Unknown	39.1	Outside on back wall of house, mid way up		
51	Microphone	Type 4193 / Type 2669	2151208	2526878	62.8	Outside, ground microphone back yard		
52	Microphone	Type 4193 / Type 2669	2305436	2351710	64.3	Intensity probe in front of back bedroom window		
53	Intensity	Type 4197 / Type 2682	2277817	2169201	1	Intensity probe in front of back bedroom window		
54	Intensity	Type 4197 / Type 2682	2277817	2169201	1	Intensity probe in front of back bedroom window		
55	Intensity	Type 4197 / Type 2682	2225991	2262123	1	Intensity probe in front of back bedroom wall		
56	Intensity	Type 4197 / Type 2682	2225991	2262123	1	Intensity probe in front of back bedroom wall		

Outdoor transducer locations during the March 2006 pretest.







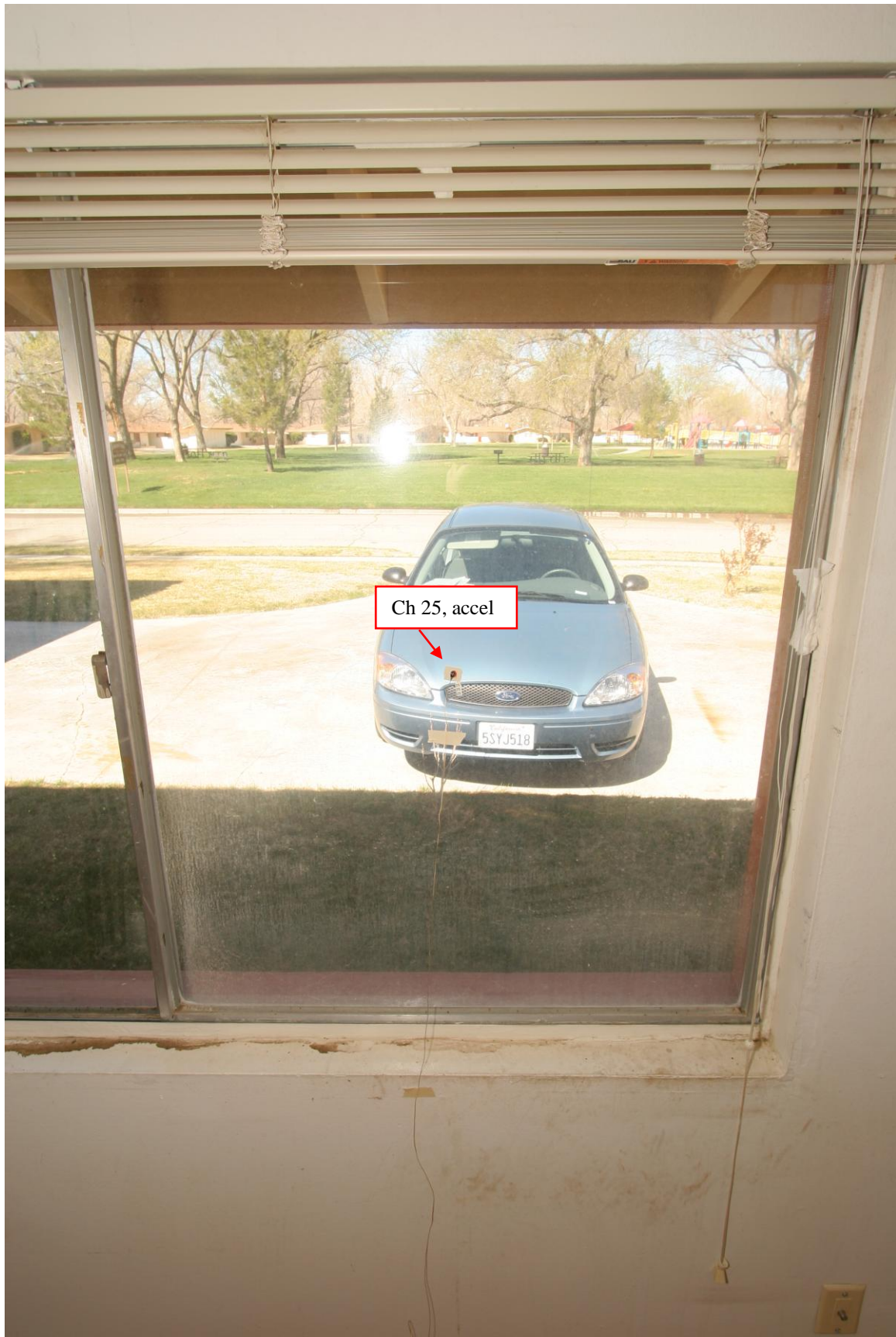


Front bedroom transducer locations during the March 2006 pretest.

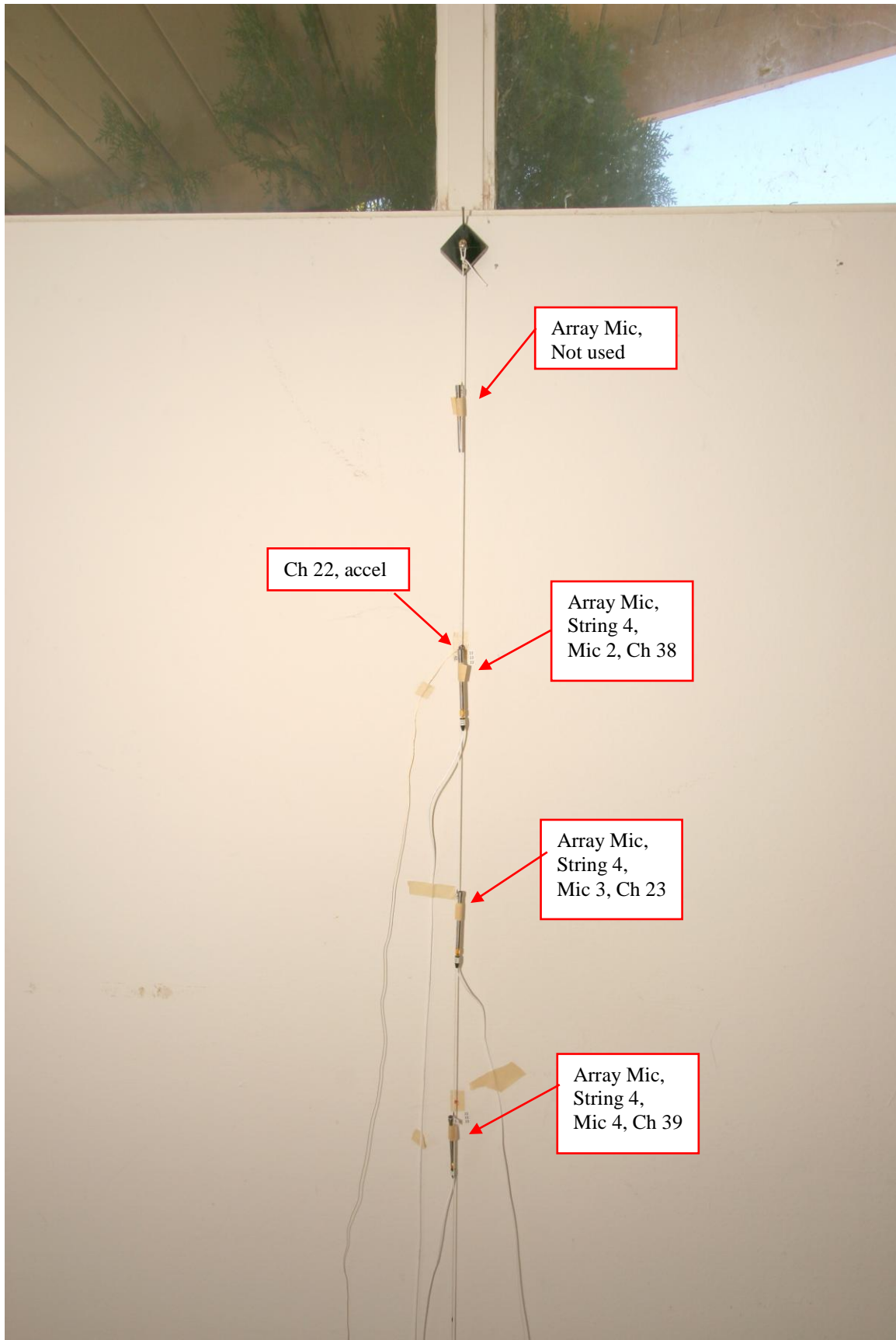






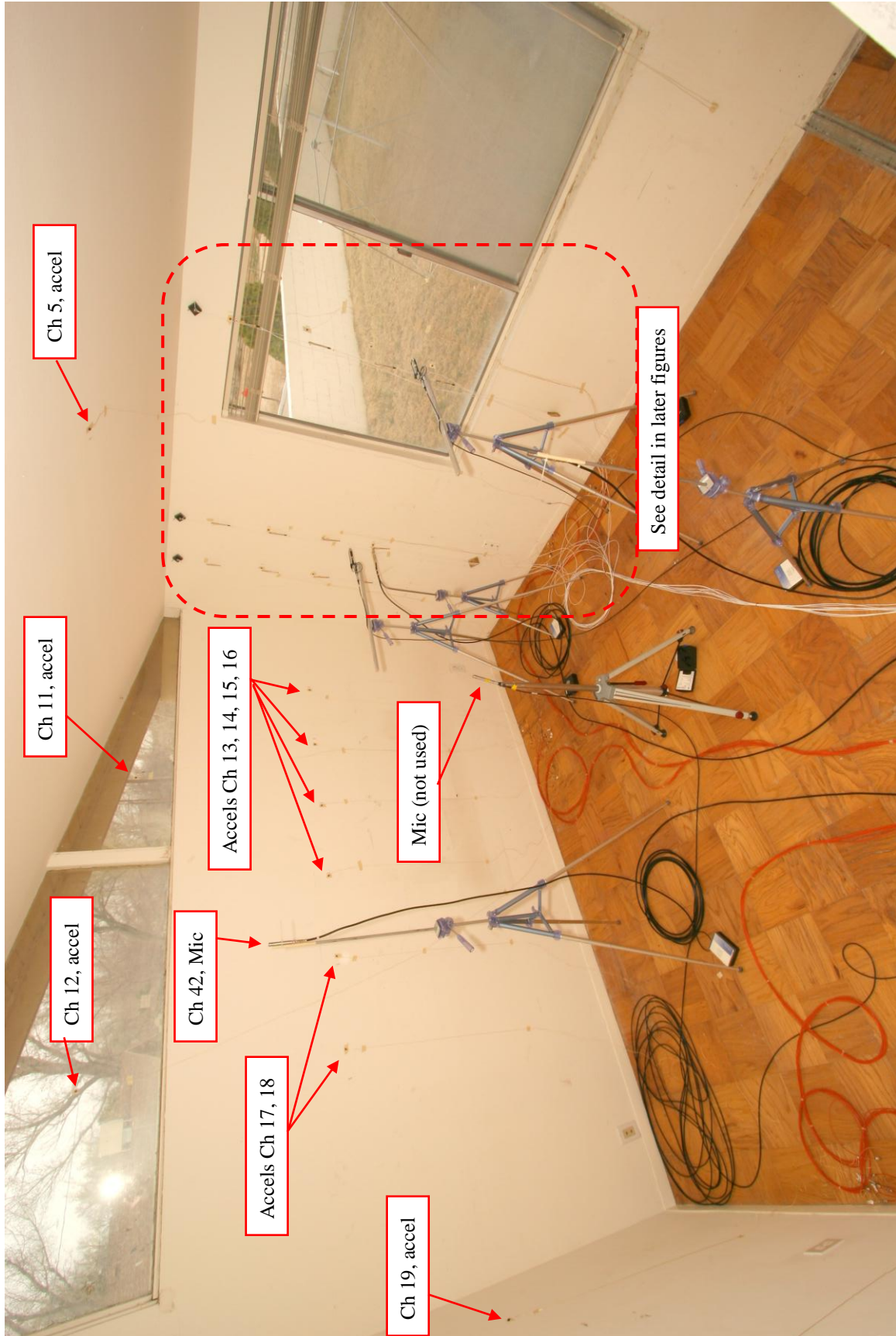


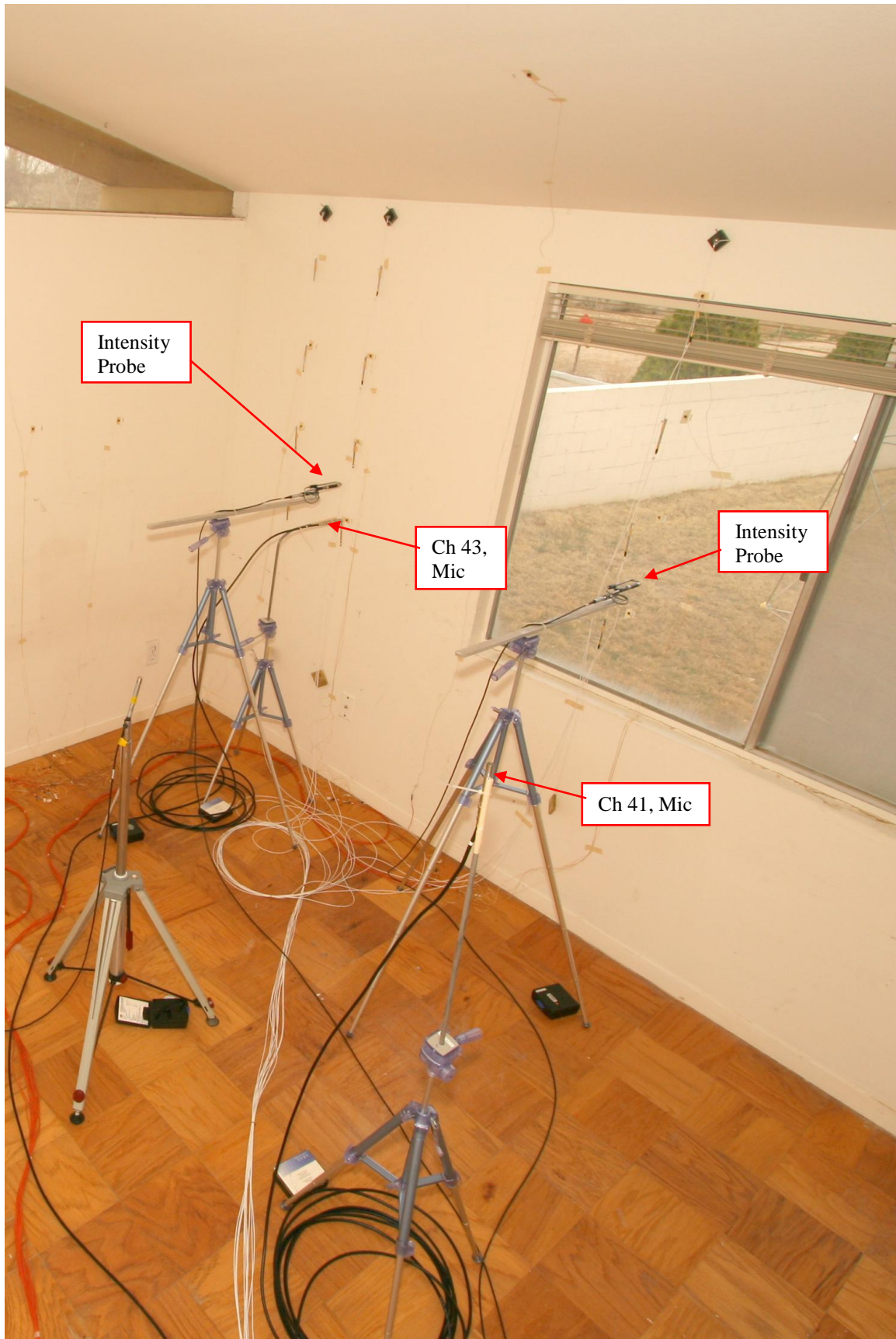


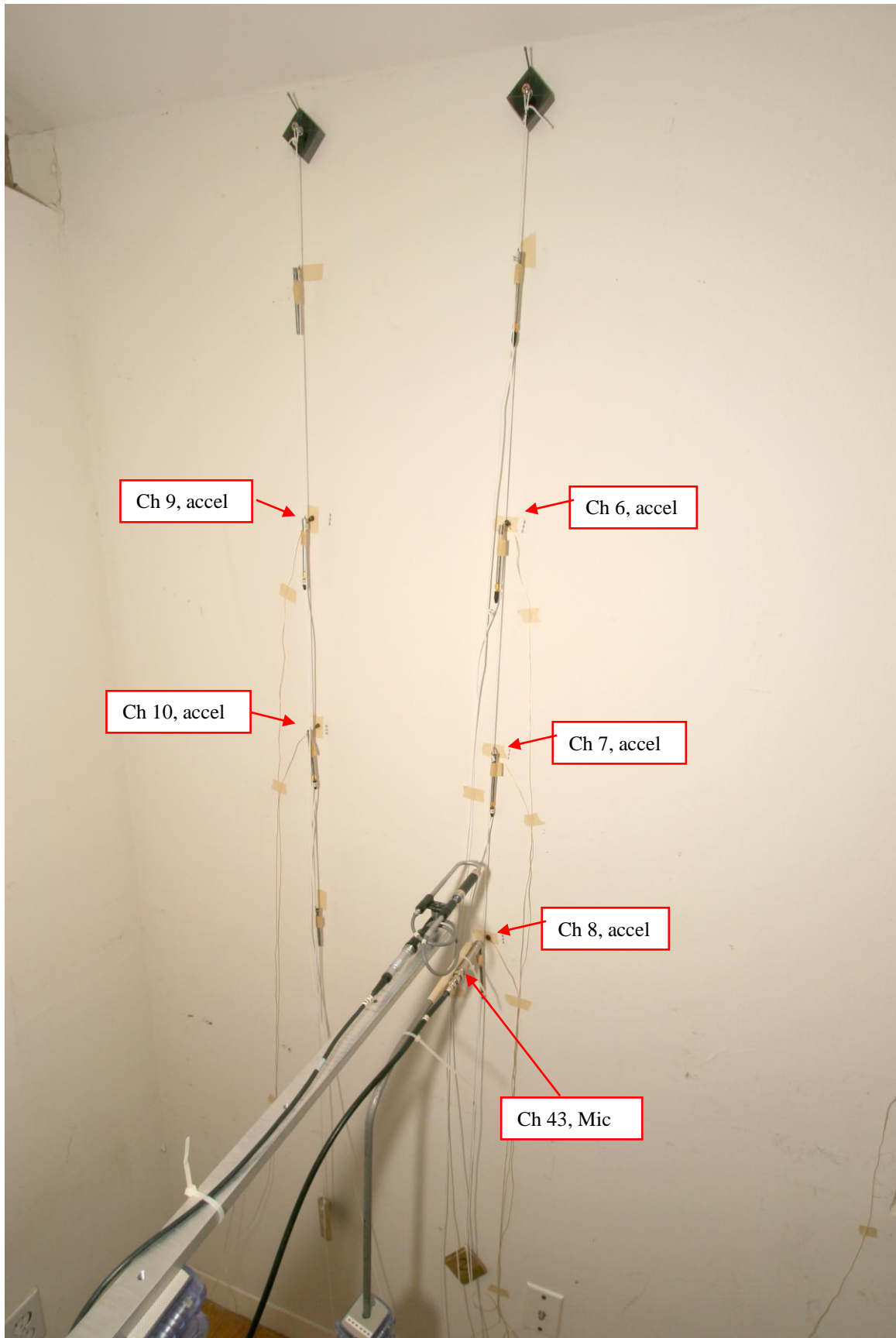


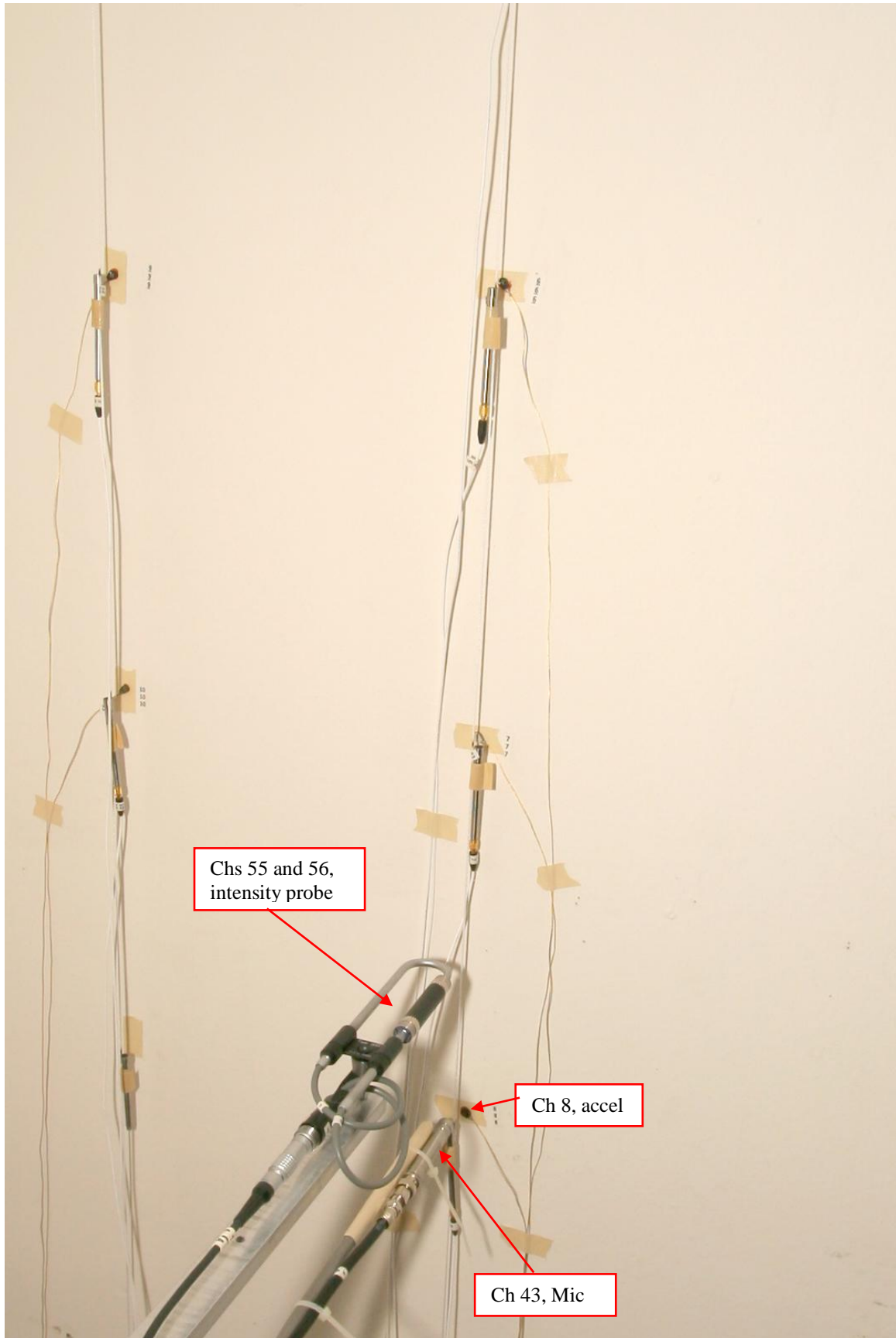


Back bedroom transducer locations during the March 2006 pretest.

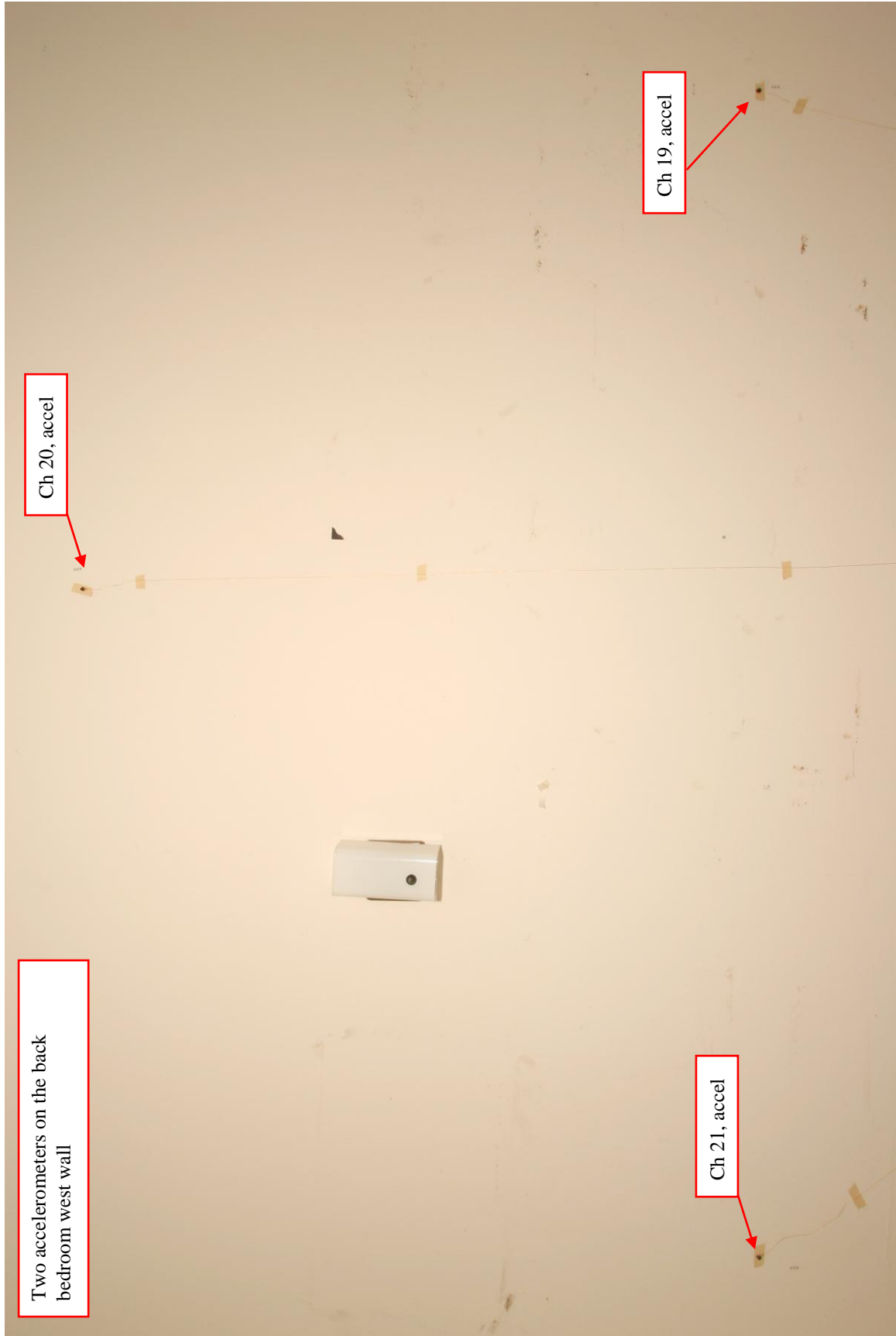








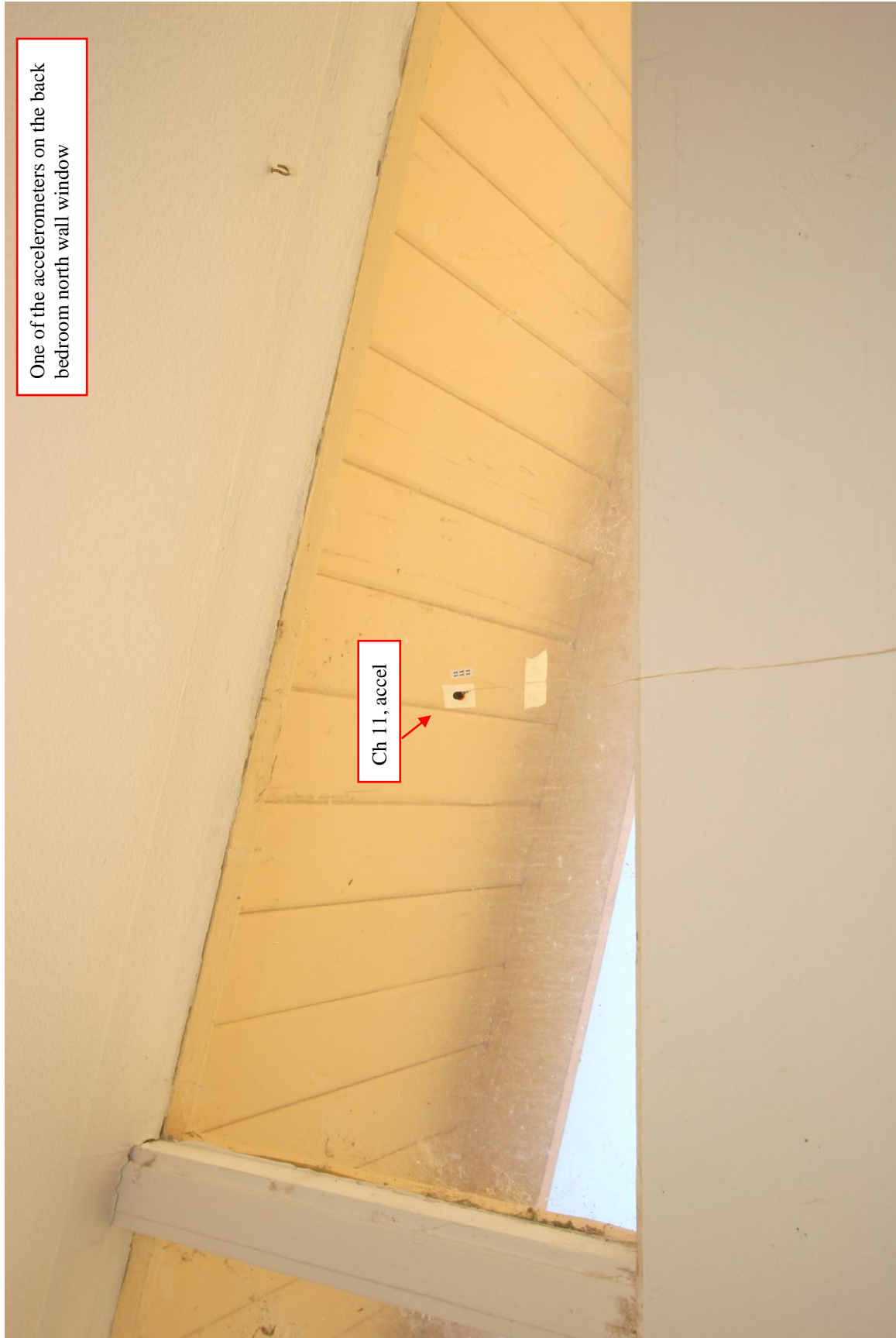


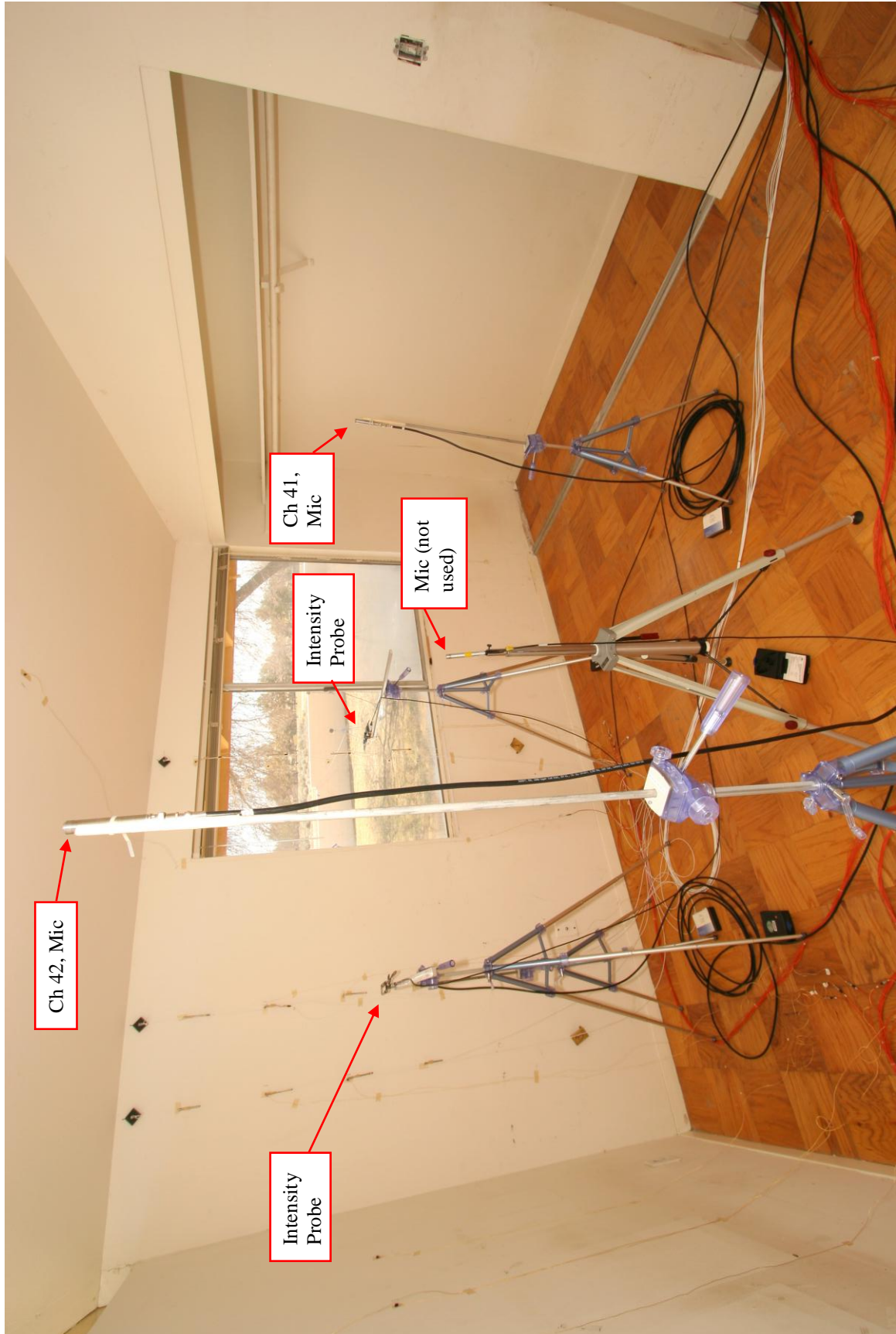


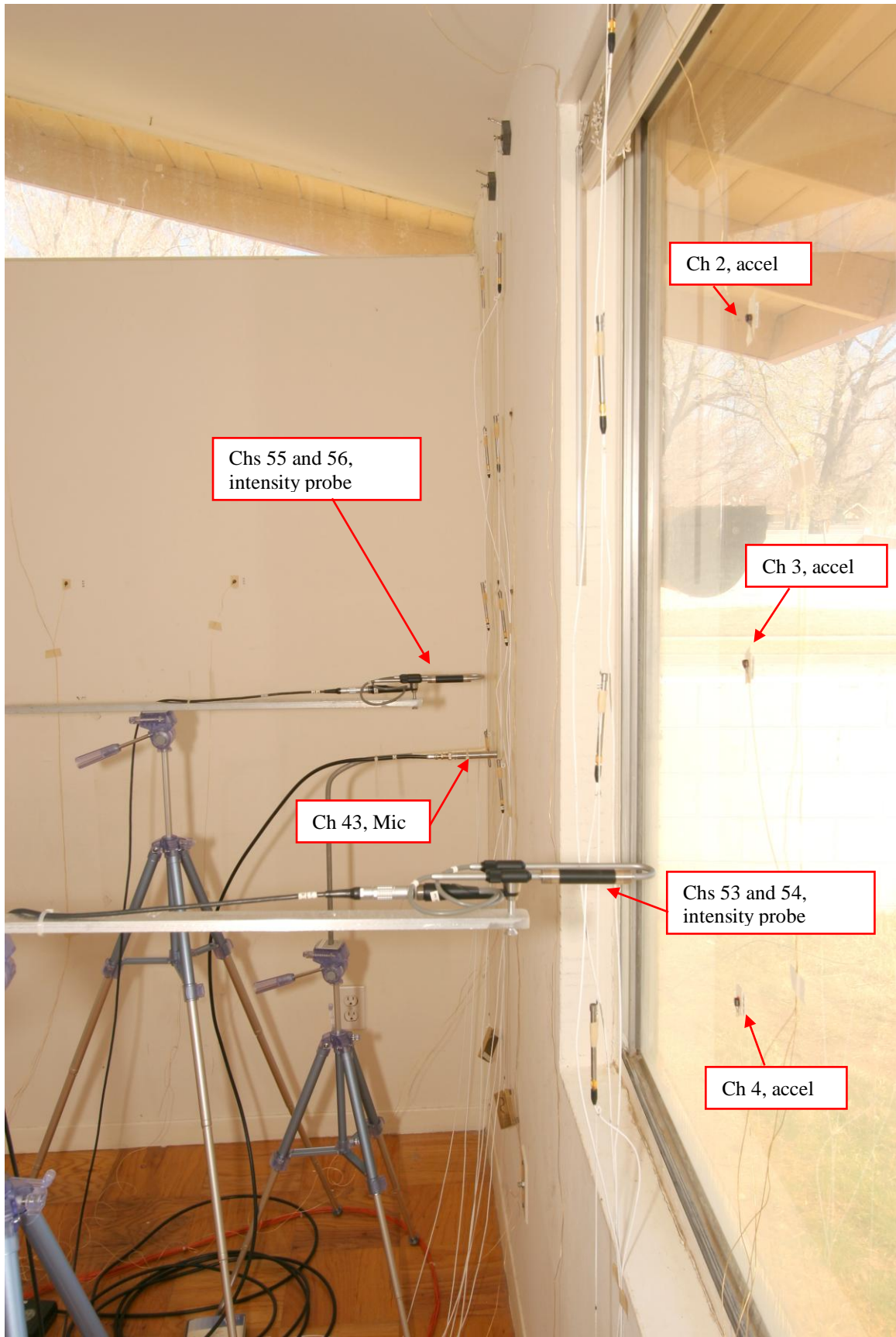


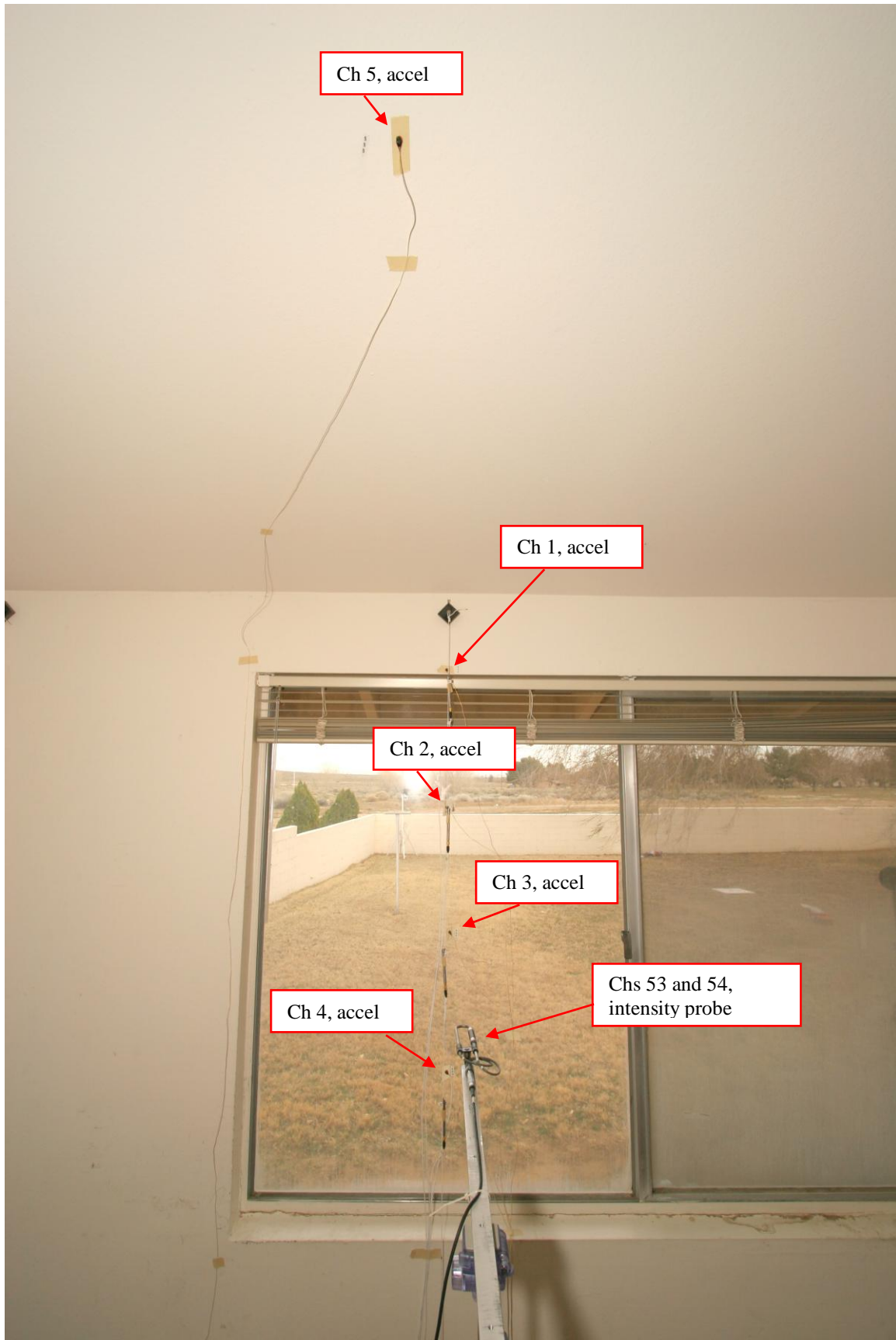


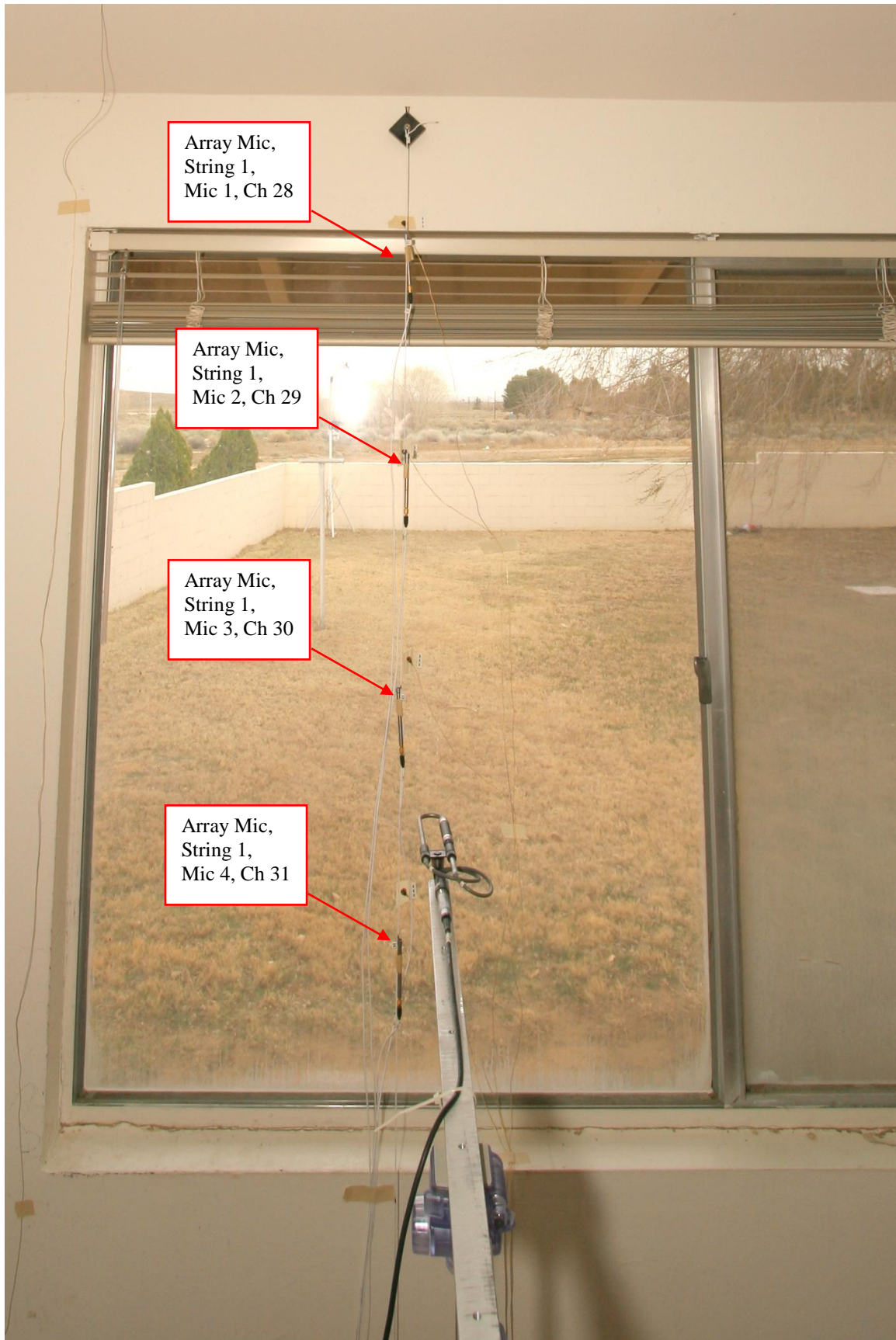


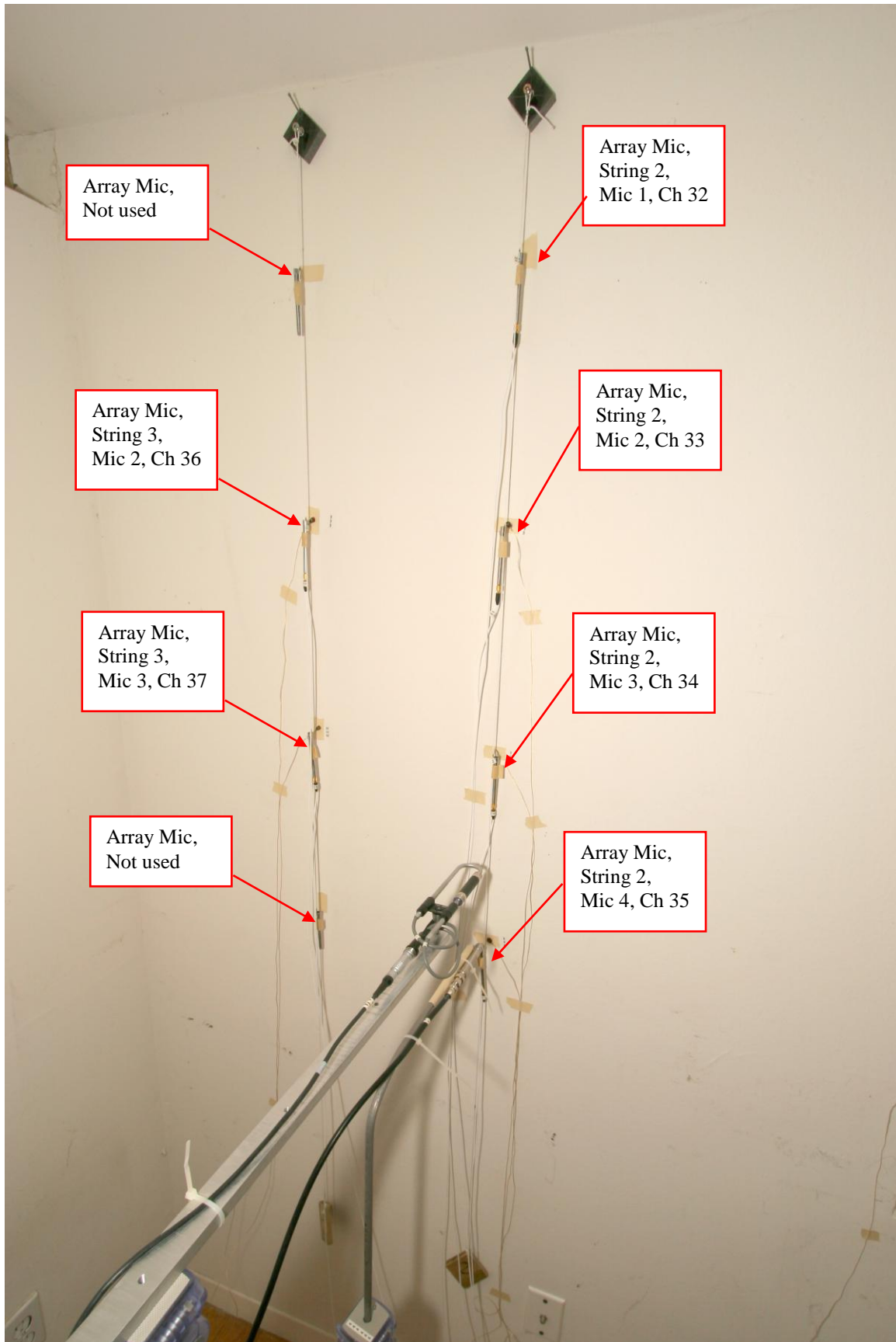


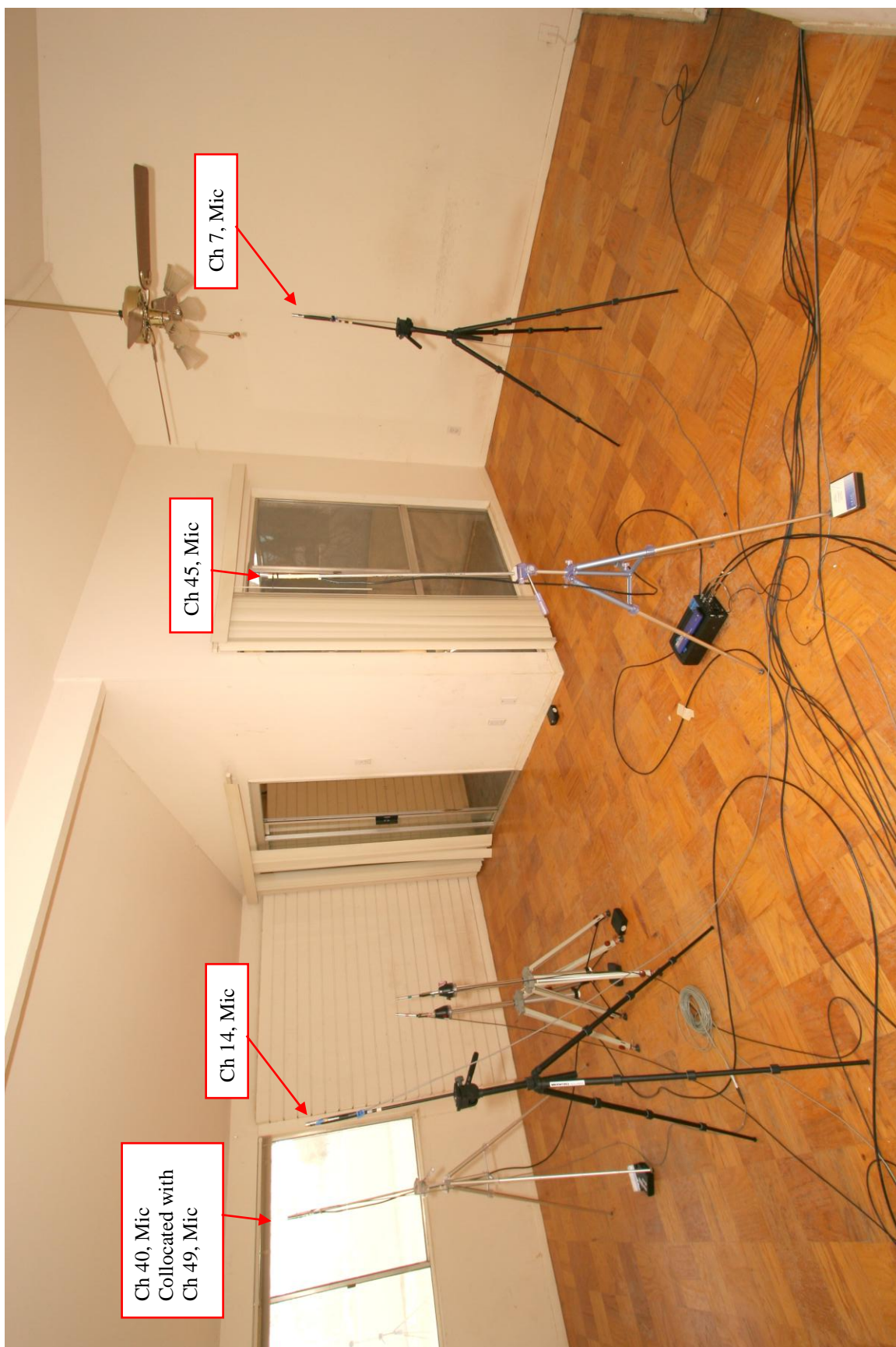












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14. ABSTRACT During the month of June 2006, a series of structural response measurements were made on a house on Edwards Air Force Base (AFB) property that was excited by sonic booms of various amplitudes. Many NASA personnel other than the authors of this report from both Langley Research Center and Dryden Flight Research Center participated in the planning, coordination, execution, and data reduction for the experiment documented in this report. The purpose of this report is to document the measurements that were made, the structure on which they were made, the conditions under which they were made, the sensors and other hardware that were used, and the data that were collected.						
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